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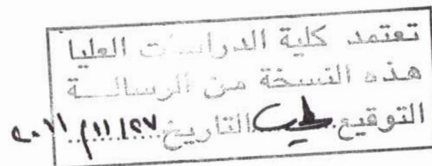
THE IMPACT OF KNOWLEDGE MANAGEMENT INFRASTRUCTURE CAPABILITIES ON KNOWLEDGE MANAGEMENT PROCESS CAPABILITIES IN THE PHARMACEUTICAL MANUFACTURING COMPANIES IN JORDAN

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This Thesis was submitted in Partial Fulfillment of the Requirements for the Degree of Master of Business Administration

Faculty of Graduate Studies
The University of Jordan



Nov,2011



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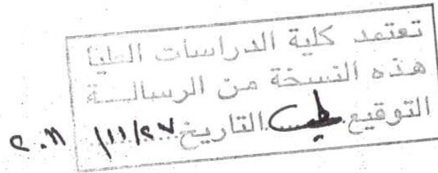
وقال رسول الله صلى الله عليه وسلم

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Committee Decision

This thesis (The Impact of Knowledge Management Infrastructure Capabilities on Knowledge Management Process Capabilities in the Pharmaceutical Manufacturing Companies in Jordan) was successfully defended and approved on 27/10/2011.

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Dedication

For God I only pray, for God I dedicate my deep thankful
pray for the power he gives me to complete this
modest work

For My Mother Soul, I always remember your tireless efforts in growing
and teaching me, my brothers, my sisters, and 35 generations you have
taught during your work as a teacher

For My father, My Brothers, My Sisters
I am proud to say that your pray was very valuable to me.

For My Sister Reem, her husband Haytham, her son Fares, and my relatives
in Jordan
I appreciate every invitation, phone call, or assistance you have done

My DAAD' Scholarship holders Colleagues and My Roommates
You were my second family

Acknowledgement

A heartfelt and deep appreciation to my supervisor

Dr. Samer Dahiyat

Without his tireless efforts, I would have not succeeded

I would like to thank DAAD (Deutscher Akademischer Austausch Dienst_ German Academic Exchange Service) for their Valuable Scholarship, without DAAD, I would have not enrolled in a Master program

Specifically, I would like to thank DAAD‘s staff Dr. Helga Baumgarten, Cyrus Salimi-Asl, and Prof. Dr. Thomas Weber

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ABSTRACT

The aim of this study is to investigate the effect of Knowledge Management Infrastructure Capabilities (Interaction, Innovative Culture, Decentralization, Integration, and Technology) on Knowledge Management Process Capabilities (Knowledge Acquisition, Knowledge Conversion, Knowledge Application, and Knowledge Protection). This study used a questionnaire-based survey which measured the study's variables. This study targeted Pharmaceutical Manufacturing Companies operating in Jordan. Twenty-one companies out of Twenty-Six participated with a response rate of eighty percent, and 203 out of 245 questionnaires were collected. Multiple regression analysis was used to investigate the effect of Knowledge Management Infrastructure Capabilities on Knowledge Management Process Capabilities. The main findings have showed that Interaction is a critical infrastructure capability for Knowledge Acquisition and Conversion processes, and Technological Infrastructure is a crucial enabler for Knowledge Application and Knowledge Protection processes. However, Decentralization and Integration do not have any statistically significant effect on all of the Knowledge Management Process Capabilities.

Furthermore, this study contributed to the related stream of studies in the area of Knowledge Management in that it is considered one of a limited number of studies that have comprehensively investigated the relationship between Knowledge Management Infrastructure Capabilities and Knowledge Management Process Capabilities, through including all of these processes. In addition, the study contributed to the Knowledge Protection literature, which suffers from a serious lack of studies covering this process.

Chapter One: Introduction

1.1 Background to the Study

In the past few years, a significant interest in knowledge management has emerged (Denning, 2006) and knowledge has become increasingly recognized as an important asset to be managed (Davenport et al., 1998; Teece, 1998). In fact, for many organizations, achieving competitiveness and sustainability is not only dependent on the successful managing of tangible assets and natural resources, but also on the effective management of its intangible assets, specifically knowledge (Lee and Sukoco, 2007). Therefore, Knowledge Management aims to facilitate the creation, storage, transfer, and application of knowledge in organizations (Gold et.al, 2001).

Many researchers have developed theories that aimed to exploit knowledge for a commercial result. For example, absorptive capacity which is defined as the ability to use prior knowledge to recognize the value of new information, assimilate it, and apply it to create new knowledge and capabilities (Cohen et al., 1990). Gold et al. (2001) established Knowledge Management Processes model that has been believed to lever organizational absorptive capacity. These processes were linked to organizations' Knowledge Management Process Capabilities include Knowledge Acquisition, Knowledge Conversion, Knowledge Application, and Knowledge Protection.

The success and failure of knowledge management processes within organizations depends on prerequisites or enablers that are necessary for the effort to success. These prerequisites were described broadly as "capabilities" or "resources" within the knowledge management and strategic management literature (Gold et al., 2001). These enablers were linked with Knowledge Management Infrastructure Capabilities that include Technological Infrastructure, Structural Infrastructure, and Cultural Infrastructure. Gold et al. (2001), Mills et al. (2010), and Anderson (2009) have

investigated the effect of these capabilities (Infrastructure and Processes) on organizational performance and knowledge management effectiveness. Although their studies did not investigate or discuss the relationship between Knowledge Management Infrastructure Capabilities and Knowledge Management Process Capabilities, but Anderson (2009) found that Knowledge Management Infrastructure Capabilities drive Knowledge Management Process Capabilities.

In the light of this relationship, this study aimed to investigate the effect of Knowledge Management Infrastructure Capabilities (Technology, Structure, and Culture) on Knowledge Management Process Capabilities (Knowledge Acquisition, Knowledge Conversion, Knowledge Application, and Knowledge Protection) in the pharmaceutical manufacturing companies operating in Jordan.

1.2 Problem Definition

The pharmaceutical industry has been known for its creation of innovative products (Horrobin, 2001). However, the innovative sources of pharmaceutical industry have decreased over the last decade. The pharmaceutical industry has unique characteristics such as a highly regulatory environment, long development cycles, and a high level of risks and costs in the R&D process. Time from discovery to marketing of a new drug requires on average 8-10 years (Ganguli, 2003). In order to sustain competitive advantage, companies invest in information technology that enables them manage their data and information. Thus, better knowledge management outcomes in a form of new products or better strategic decisions (Gold et al., 2001; Sveiby, 1997).

Although that investments have yielded marginal results, but Lucier et al. (1997) found that approximately 84% of knowledge management programs fail to have any real outcomes on financial performance or operating performance. Examples for the failure

causes include lack of strategic alignment with the firm's objectives, organizational culture, structure (Stankowsky, 2005), and processes (Gold et al., 2001). On the other hand, Lawton (2001) noted that at least half of failed knowledge management initiatives are due to firms not considering their KM implementation processes and the Infrastructure needed for such processes (Gold et al., 2001).

According to Gold et al., (2001), the problem of ineffective knowledge management is that firms are not considering their capabilities before implementing knowledge management programs. These capabilities include Infrastructure Capabilities and Knowledge Management Process Capabilities. Andrson (2009) found that Structural Infrastructure, Cultural Infrastructure, and Technological Infrastructure drive Knowledge Acquisition Process, Knowledge Conversion Process, Knowledge Application Process, and Knowledge Protection Process. Therefore, companies that tend to launch knowledge management programs or apply knowledge management processes without consideration of their Infrastructure Capabilities reduce their chances of successful implementation (Gold et al., 2001; Anderson 2009).

In the light of problem definition, this study aims to investigate the effect of Knowledge Management Infrastructure Capabilities (Interaction, Innovative Culture, Decentralization, Integration, and Technology) on Knowledge Management Process Capabilities (Acquisition, Conversion, Application, and Protection) in the pharmaceutical manufacturing companies operating in Jordan, and to identify the most important infrastructural dimensions that can facilitate the efficient implementation of Knowledge Management Process.

1.3 The Importance of Study

It has been noticed in the previous studies that KM Processes lack a standardized process. Such processes include Knowledge creation, sharing, transfer, acquisition, application, utilization, conversion, integration, and protection. However, these processes might intersect with each other in a part, or it has different operational definition for the same process. This study investigated the most known comprehensive KM processes set which include Knowledge Acquisition, Knowledge Conversion, Knowledge Application, and Knowledge Protection (Gold et al., 2001). To facilitate applying theses processes, a set of the most important infrastructure capabilities have been chosen, which includes Interaction, Innovative Culture, Decentralization, Integration, and Technology. Investigating the relationship between KM Infrastructure Capabilities and KM Processes guides the pharmaceutical manufacturing companies operating in Jordan to apply KM Processes effectively, specifically by identifying the most important infrastructure capabilities that facilitate them.

This study contributes to the previous studies. It has examined new relationships that lack empirical evidences as well as supports the previous studies. More specifically, this study is considered the first known study in Jordan that investigates the effect of KM Infrastructure capabilities on Gold’s et al. (2001) KM Process Capabilities (Acquisition, Conversion, Application, and Protection Processes). In addition, Gold et al. (2001) was a pioneer in considering Knowledge Protection Process as a part of KM processes. It has been noticed that Knowledge Protection Process is the least process that has been investigated empirically.

1.4 Research Objectives

In the light of the aforementioned research problem and importance of the study, a set of objectives have emerged to achieve the aim of the study:

1- To identify the extent to which KM Infrastructure capabilities exist in pharmaceutical manufacturing companies operating in Jordan.

2- To identify the extent to which KM Process capabilities exist in pharmaceutical manufacturing companies operating in Jordan.

3- Investigate the nature of relationship between KM Infrastructure Capabilities and KM Process Capabilities.

4- To identify the most important KM infrastructural capabilities that affect Knowledge Management Processes Capabilities.

1.5 Study Limitations

The researcher encountered some problems in gaining access to managers and the qualified employees who are relevant to fill the questionnaire. HR department in the participated companies was responsible for distributing the questionnaire to those who are qualified to fill it. In addition, part of the companies refused to participate in the study, which decreased the number of participants, and that may cause problems related to generalizablity.

In addition, many scholars discussed the Knowledge Management Process (Kim et al., 2010; Chen et al., 2010; Chen et al., 2007; Anderson, 2009; Gold et al., 2001). It has been noticed in these studies that: (1) Not all of those processes have the same practices (i.e not standardized). (2) None of them has discussed the relationship between Knowledge Management Infrastructure Capabilities (Interaction, Innovative Culture,

Decentralization, Integration, and Technology) and Knowledge Management Process Capabilities (Knowledge Acquisition, Knowledge Conversion, Knowledge Application, and Knowledge Protection) comprehensively. (3) Knowledge Protection Process was considered by Gold et al. (2001) as a fourth process which has not been investigated in the previous studies. More specifically, Knowledge Protection Process has not been investigated by the KM Infrastructure Capabilities in the previous studies.

The results of study may be limited to pharmaceutical manufacturing companies operating in Jordan. Therefore, results may be changed by industry or culture. A set of cultural and structural traits have not been investigated in the study that might have a contribution in predicting the KM Processes. These traits include trust, informality, learning culture, loyalty, employee satisfaction, managerial commitment and empowerment.

In the light of these limitations, these limitations are considered to be a new area for further research. Future research is recommended to investigate more cultural and structural traits, and to link KM infrastructure capabilities and KM Process Capabilities with innovativeness, KM effectiveness, and Organizational performance. In addition, investigate the effect of KM Infrastructure Capabilities on KM Process Capabilities in related sectors. Thus, investigate the significance effect of decentralized and integrated structure, which has shown insignificance effect in this study and insignificant in other.

1.6 Research Outline

This research consists of five chapters, distributed as follow:

Chapter One: Includes the introduction in which an overview in terms of the research problem, objectives, limitations, and questions is provided.

Chapter Two: Includes the literature review where a comprehensive and thorough literature review of prior and latest studies and conceptual frameworks will be provided and analyzed.

Chapter Three: Includes the methodology in which the research theoretical framework and hypotheses with explanations of the independent and dependent variables and how data will be gathered and measured are clarified.

Chapter Four: Includes the data analysis in which data will be statistically analyzed in order to demonstrate the characteristics of the population and to test study hypotheses.

Chapter Five: Includes the findings, discussions and recommendations.

Chapter Two: Literature Review

2.1 Introduction

This chapter offers a basis for understanding the concept of knowledge management from the perspective of organizational capabilities. A discussion of the different perspectives is presented to provide an overall background that introduces and discusses both KM Infrastructure Capabilities and KM Process Capabilities and the relationship between them.

2.2 Knowledge Management Definitions

Before defining the knowledge management, defining the following basic terms give a solid base to the meaning of knowledge management and the literature. These basic concepts are: Data, Information, Knowledge, Organizational Knowledge**,** Explicit Knowledge, and Tacit Knowledge.

First, Hinds and Aronson (2002) defined **Data** as the raw material for the production of information. Second, **Information** is the product of structuring data and adding relevance and purpose (Davenport and Prusak, 1998, p. 2). In addition, **Information** is "data that makes a difference" because without context, information is simply a string of data (Davenport and Prusak 1998, p. 3). Third, **Knowledge** is information in action (O'Dell et al., 1998) or information applied to solve a problem (Hinds and Aronson, 2002). Davenport and Prusak (1998, p. 5) defined knowledge as "a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences. It originates and is applied in the mind of knowers".

Organizational Knowledge refers to the "understanding and beliefs in a firm about the relationship between the firm and its environment" (Smith et al., 2005, p. 347).

There are two forms for the knowledge embedded in the employees and manuals, Explicit and Tacit knowledge. Nonaka (1991) theorized that **Explicit Knowledge** is formal and systematic, such as product specifications, computer programs, and mathematical formulas. Nickols (2000) considered Explicit knowledge to be information that has been captured in the form of text, tables, diagrams, product specifications, and reports. **Tacit knowledge** is the combination of an individual's instinct, insight, learning, understanding, and experience (Nonaka, 1991). In addition, Tacit knowledge is not easily expressed, as it cannot be easily articulated.

There are many **Knowledge Management** definitions adopted by researchers. Rastogi (2000, p. 40) defines knowledge management as "a systematic and integrative process of coordinating organization-wide activities of acquiring, creating, storing, sharing, diffusing, developing, and employing knowledge by individuals and groups in pursuit of major organizational goals". Duffy (2000, p. 64) defined knowledge management as "a process that drives innovation by capitalizing on organizational intellect and experience". Alavi and Leidner (2001) described knowledge management as distinct but interdependent processes to create, store, retrieve, transfer, and apply knowledge.

Jennex (2005) defined KM as the practice of selectively applying knowledge from previous experiences of decision-making to current and future decision-making activities with the express purpose of improving organizational effectiveness. Gloet and Terziovski (2004) described knowledge management as an umbrella term encompassing the fields of knowledge creation, knowledge sharing, knowledge mapping and indexing, knowledge distribution and storage, and knowledge valuation and metrics.

This study adopts Lakshman's (2007, p. 55) definition since it considers the organizational capabilities that allow people in organizations, either working as individuals, in teams, or projects, to create, capture, share, and leverage their collective knowledge to improve performance.

2.3 Theoretical Foundation of Knowledge Management

The Knowledge Management has been discussed in many theories and perspectives. The research model was adopted for this study depends on the organizational capabilities perspective theory (Gold et al. (2001). This theory is grounded in knowledge integration (Grant, 1996), the resource-based view (Wernerfelt, 1984), the knowledge-based view of the firm (Barney, 1991), Social Capital (Gold et al., 2001), and Absorptive Capacity (Cohen & Levinthal, 1990).

2.3.1. Resource-Based View

In the 1980s, Wernerfelt (1984) established the term "resource-based view," which has become a core idea in strategic-management theory. This theory shifted the view of the transaction-cost approach that argued that competitive advantage referred to the external competitive environment (Porter, 1980). The resource-based view argued that internal proficiencies (core competencies) became the source that yielded a competitive advantage (Barney, 1991).

The core competency was difficult to be imitated, widely leveraged by the company, and provided customer benefits (Prahalad and Hamel, 1990). As a result, Barney (1991) proposed that a firm has four basic resources: financial assets, physical assets, human assets, and organizational assets. To achieve a sustained competitive advantage the firm

must develop these resources into capabilities that meet four conditions: value, rareness, inimitability, and non-substitutability.

Based on Resource-Based view, Knowledge-Based view has emerged. Scholars of the knowledge-based view argued that knowledge is the most strategically important resource because it is difficult to imitate and provides the firm with the potential for long-term competitive advantage and innovation (Gold et al., 2001; Nonaka & Takeuchi, 1995; Spender, 1996; Sveiby, 2001; Teece et al., 1997). Grant (1996) linked the resource-based view of the firm to the knowledge-based view when he proposed that the firm's collective knowledge resources, that have been networked, linked, and transferred to the organization, define organizational capability.

Drucker (1992) proposed that knowledge resources are everywhere and limited only to the firm's ability to recognize them. Drucker (1992, p.164) emphasized that they are embedded in multiple entities, "including organizational culture and identity, routines, policies, systems, and documents, as well as individual employees". Knowledge resources have unique characteristics as pointed out by Apostolou and Mentzas, (2003):

1. Knowledge assets are not inherently scarce.

2. Knowledge assets are regenerative, meaning that in addition to the outputs of products and services, new relevant knowledge may emerge.

3. Knowledge assets often increase in value the more they are used, whereas in the resource-based view the resources exhibit decreasing returns to use.

2.3.2. Knowledge Integration

Knowledge can be held by individuals as well as collectively by the organization (Spender, 1996). Grant (1996) discussed knowledge Integration. He argued that collective knowledge exists when the efforts of employees with complementary skills and expertise are combined, and through the process of knowledge integration, that collective knowledge is transformed to the organization. Firms with better knowledge integration processes will have stronger knowledge management capability, making them better equipped to sustain competitiveness.

2.3.3. Absorptive Capacity

The ability to exploit external knowledge is considered as a source of innovative opportunities. Cohen & Levinthal (1990) argued that the ability to evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge. This prior knowledge includes basic skills or even a shared language but may also include knowledge of the most recent scientific or technological developments in a given field. Thus, prior related knowledge gives an ability to recognize the value of new information, assimilate it, and apply it to commercial ends. These abilities collectively constitute what we call a firm's “absorptive capacity”. Jolly and Thérin (2007) asserted that absorptive capacity is a function of the education level and permeability of employees, the technological infrastructure, and management support. Absorptive capacity is essential for developing and maintaining organizational capabilities (Bhatt, 2001, Gold et al., 2001). It enables a firm to learn, reflect, and relearn (Lin, 2007).

Building on the theory of absorptive capacity, Zahra and George (2002) distinguished between potential and actual capacity which influence a firm’s competitive advantage. Potential capacity refers to acquisition and assimilation capabilities whereas realized or

actual capacity focuses on knowledge transformation and exploitation. Zahra and George (2002) argued that potential capacity contributes to strategic flexibility and the ability to adapt to environmental change. They define absorptive capacity as the "set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability" (Zahra and George, 2002, p. 186).

2.3.4 Social Capital

In order to share knowledge, integrate knowledge and create new knowledge, firms need to consider its social capital (Gold et al., 2001; Grant, 1997 Nahapiet & Ghoshal, 1998). The idea of social-capital theory is that the social interactions of people become a resource for creating and storing collective knowledge (Nahapiet & Ghoshal, 1998). Social capital is the collective sum of the resources that are held in, accessible through, and derived from a network of social relationships (Nahapiet & Ghoshal, 1998). From the perspective of social capital theory, Grant (1996) argued that the firm's collective knowledge resources that are networked, linked, and transferred to the organization define organizational capability.

2.4 Knowledge Management Capabilities: Infrastructure and Processes

This section discusses the Infrastructure Capabilities and Process Capabilities. It explains the relationship between Infrastructure and Processes as well as explains the role they play for successful knowledge management processes.

2.4.1 Relationship between Infrastructure Capabilities and Processes Capabilities

It has been indicated that knowledge-based view emphasizes the role of knowledge in achieving a competitive advantage (Gold et al., 2001; Nonaka & Takeuchi, 1995;), while the perspective of organizational capability (Gold et al., 2001) focuses on developing resources to improve organizational performance. Resources consist of both intangible and tangible assets, while capabilities are process-based resources that are less visible and less tangible than other resources (Anderson, 2009). Grant (1991) distinguished capabilities from resources by defining a resource as an input of the production process and a capability as the use of the resources. Later, Grant (1996) defined organizational capabilities as the firm's ability to network, link, and integrate its knowledge resources.

New organizational resources, including knowledge, are created through the processes of combination and exchange (Gold et al., 2001; Nonaka, 1994), which require the presence of social capital (Nonaka, 1994) -that is the sum of actual and potential resources embedded within, available through, and derived from the network of relationships possessed by a social unit". Three key infrastructures enable maximization of social capital, technical, structural and cultural (Gold et al., 2001). Structural infrastructure refers to the decentralization and integration (Chen et al., 2007; Chen et al., 2010); Interaction and innovativeness comprise the cultural dimension (Gold et al., 2001; Peachey, 2006; Bock et al., 2005); and the technological dimension addresses the technology-enabled ties that exist within the firm and with partners, and technology-enabled knowledge acquisition, storage, and retrieval (Davenport et al., 1998a, Davenport et al., 1998b; Teece, 1998; Gold et al., 2001; Lee and Lee, 2007).

On the other hand, KM processes must be presented to lever infrastructure, (Almeida 1996; Appleyard, 1996; Grant 1995; Leonard 1997; Nonaka et al., 1998; Nonaka et al., 1995, Porter -Liebskind, 1996; . Spender, 1996; Sziilanski, 1996; cited in Gold et al., 2001) as well as it levers organization's absorptive capacity in that it manages routines and processes to acquire, assimilate, transform, and exploit knowledge (Gold et al., 2001; Cohen & Levinthal, 1990). Based on Knowledge-Based view, Tacit Knowledge is considered as a critical source that should be shared, transferred, and integrated by the organization to achieve competitive advantage (e.g., Grant, 1996; Nonaka & Takeuchi, 1995; Raisinghani, 2000; Yang & Chen, 2007).

Based on Absorptive Capacity and Knowledge-Based view, integration capability as a knowledge management process capability has emerged. Gold et al. (2001) operationalized knowledge integration through four knowledge management process activities— acquisition, conversion, application, and protection. They empirically examined these capabilities on knowledge management effectiveness, and they found a positive relationship between these capabilities and organizational effectiveness.

Lee and Choi (2000) investigated the relationship between knowledge management processes and enablers such as organizational structure, culture, and information technologies. They adopted both non-financial and financial performance measures to measure the effect of knowledge management. The findings of their study imply that knowledge management processes are significant predictors for organizational creativity. Organizational structure and culture are found to be significant in predicting the knowledge management processes. In addition, it is noted that technology-related variables are not significantly related to the knowledge management.

Peachey (2006) examined the effects of culture, climate, intrinsic motivators, structure and technological capabilities on knowledge management effectiveness when structure is moderated by technological capabilities. Their research found evidence that climatic factors including fairness and affiliation as well as intrinsic motivators and technology affect knowledge management effectiveness.

Lee et al., (2007) examined structural relationships among the capabilities, processes, and performance of knowledge management. They found that there were statistically significant relationships among knowledge management capabilities, processes, and performance.

Anderson (2009) established new ground in the field of knowledge management by examining the relationships between knowledge infrastructure capability, knowledge process capability, and organizational effectiveness –that has been taken from Gold et al.(2001)- from the dual perspective of the team (within business units) in contrast to the organization (across business units). He found that knowledge infrastructure drives knowledge processes, that organization-level knowledge processes drive team-level knowledge processes, and that knowledge protection is seen as a corporate responsibility rather than a team or individual responsibility.

Mills et al. (2011) reexamined Gold et al. (2001) organizational capabilities perspective model and evaluated the effect of specific knowledge management resources (i.e. knowledge management enablers and processes) on organizational performance. Their results showed that some knowledge resources (e.g. organizational structure, knowledge application) are directly related to organizational performance, while others (e.g. technology, knowledge conversion), though important preconditions for knowledge management, are not directly related to organizational performance.

2.4.2 Research Theoretical Framework

Based on the literature review of this research and the study objectives, the theoretical research Theoretical framework was developed. Figure (1) displays the theoretical model that illustrates the relationship between the study variables.

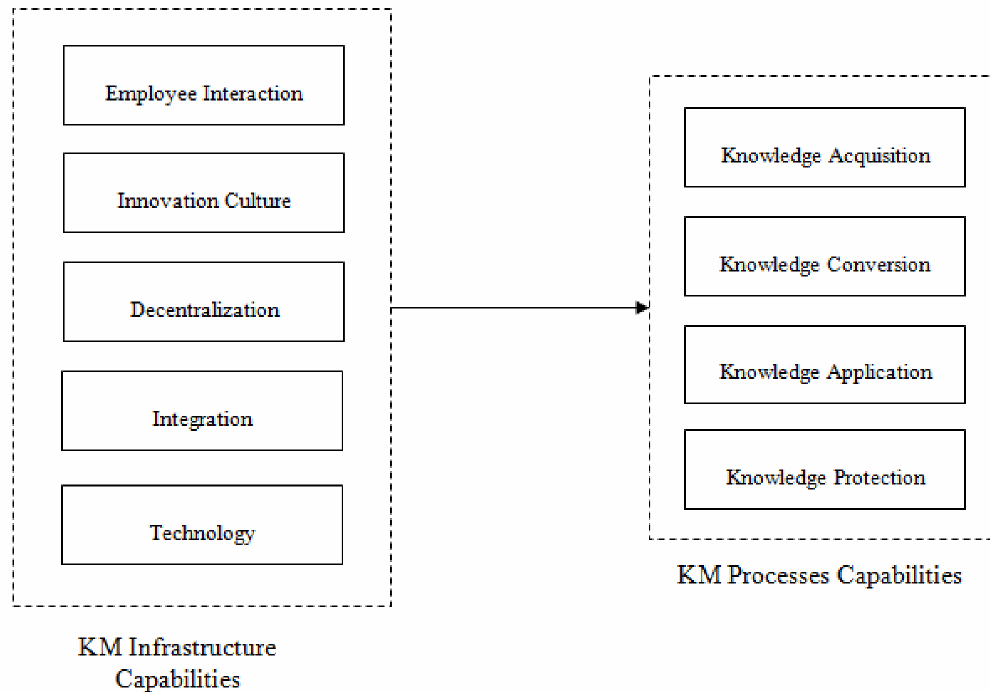


Figure 1 : Research Theoretical Framework

2.4.3 Infrastructure Capabilities

Paisittanand et al. (2007, p. 85) defined infrastructure capability as "the capability to manage infrastructures in the organization in order to support and facilitate organizational activities". Thus, becoming a knowledge organization involves an organizational changing includes the changing and rebuilding of technology, structures, and behaviors. Therefore, a firm must develop the capabilities that allow it to recognize opportunities for knowledge management processes (Gold et al., 2001; Grant, 1996) and

as a result, maximize social capital (Gold et al., 2001; Nahapiet and Ghoshal, 1998). Gold et al. (2001) argued that social capital is maximized through three dimensions of infrastructure capabilities: structural, cultural, and technological. Technology was considered as a critical enabler of knowledge management (Alavi and Leidner, 2001), effective knowledge management requires social support (cultural and structural) in addition to technological solutions (Gold et al., 2001).

2.4.3.1 Technological Infrastructure

The technology element of knowledge infrastructure comprises Information Technology (IT) systems that enable the integration of information and knowledge in the organization, allow integration of previously fragmented flows of knowledge, and mobilize social capital creation, transfer, storage, communication among employees and partners, and safe-keeping of the firm's knowledge resource (Gold et al., 2001; Alavi & Leidner, 2001). In addition, communication network as an important part of technology infrastructure eliminates communication barriers that occur between business units (Gold et al., 2001; Holsapple and Joshi, 2001; Leek et al., 2003). It enables employees to skip artificial barriers of structure and culture (Orlikowski, 2000), enables particular structures (Holsapple and Joshi, 2001), it can also enhance the interaction organization, and inter-organizational knowledge (Hedlund, 1994; Nonaka & Takeuchi, 1995). An additional required technological functionality includes usable storage and retrieval mechanisms (Gold et al., 2001). It has been found that IT was an essential enabler of employees' knowledge acquisition and knowledge application (Kim et al., 2007).

Ten categories of software may provide support to KM programs including, intranet-based systems, content-based systems, groupware, workflow, artificial intelligence systems, business intelligence systems, knowledge mapping systems, innovation support tools, competitive intelligence tools, and knowledge portals (de Carvalho and Ferreira, 2006).

2.4.3.2 Structural Infrastructure

A number of academic papers have discussed issues related to organizational structure and knowledge management. Structure includes rules, policies, procedures, processes, hierarchy of reporting relationships, incentive systems, norms and trust mechanisms, and departmental boundaries that organize tasks within the firm (Gold et al., 2001; Nonaka, 1991; O'Dell et al., 1998). An effective knowledge management structure is one that encourages creativity (Nonaka, 1996; Ruggles, 1998). It is necessary for leveraging the firm's technological architecture and communication networks (Gold et al., 2001). Although structural elements often have inhibited collaboration and the sharing of knowledge (Gold et al., 2001; O'Dell and Grayson, 1998), resulting in a barrier to effective knowledge management, while reducing hierarchies in organizations increases knowledge creation and transfer between employees (Nonaka, 1994) and enhance collaboration (Alavi and Leidner, 2001).

In Addition, Grant (1996) asserted that a traditional hierarchical structure is more useful for processing information than for integrating knowledge, while Nonaka (1994) suggested that hierarchical structures do not facilitate tacit-to-tacit knowledge transfer. Accordingly, a hierarchical structure will be problematic when higher-level decisions require the tacit knowledge of lower-level employees (Grant, 1996). In a survey of 431 organizations, organizational structure was the fourth highest rated item with 28% of

respondents identifying it as an impediment to knowledge transfer (Ruggles, 1998). As it has noticed that organizational structure can promote or inhibit interaction and collaboration (O'Dell and Grayson, 1998).

The natural human tendency to hoard knowledge that perceived as a source of power (Davenport and Prusak, 1998) is also promoted by rewarding individualistic behavior (O'Dell and Grayson). Reward systems are often based on individual efforts and should be structured around sharing knowledge (Scheraga, 1998) and collaboration (Gold et al., 2001).

Organizational structure was cited in the literature as having a positive effect on knowledge sharing (Chen et al., 2010). The aspects of structure that support knowledge sharing are being flatter and shallow hierarchies to enable quick decision making (Teece, 2000), having a dynamic rather than a static structure, supporting empowerment of people, emphasizing the importance of competencies, and recognizing intellect and knowledge as leveragable assets (Nonaka and Takeuchi, 1995). Nonaka and Takeuchi (1995) argued that a combination of formal and non-hierarchical/self-organizing organizational structures improve knowledge creation and sharing.

Two types of structures _a modular design and a hypertext organizational design_ have received positive discussion for KM (Gold et al., 2001). A modular design has been shown to increase strategic flexibility (Sanchez and Mahoney, 1996), while Nonaka and Takeuchi's (1995) hypertext organization enables efficient knowledge creation. Nonaka (1991, 1994) posited that knowledge-based organization designs are flatter and more dynamic, will empower people at all levels, and appreciate intellect as a resource. Sanchez and Mahoney (1996) suggested that flexibility is an essential structural design

component of an effective knowledge management system. Sutton (2001) added that flexibility enables the firm to adapt as new knowledge is acquired.

Centralization as cited in Chen (2010) may have disadvantages on knowledge management in organizations because top-down directives would reinforce an environment of fear, distrust, and internal competition while decreasing collaborations and integrative actions (Senge, 1997). Centralization creates a non-participatory environment which employees do not have freedom independence to determine what actions are required and how best to execute activities (Damanpour, 1991).

However, if individuals are allowed to determine what actions are required and how best to execute activities. Thus, they would have the opportunity to provide inputs and further share their ideas during the decision-making process (Yap et al., 1998). Furthermore, employees would be more capable of developing and exchanging new knowledge and skills to solve new or existing problems if they are allowed to have autonomy. Therefore, the less centralized structure _Decentralized_ would facilitate knowledge management within the firm.

Formalization refers to the degree of codified rules and procedures existing in organizations to guide employee behaviors and work processes (Andrews and Kacmar, 2001). Formalization is used to achieve production efficiency by means of guaranteeing adherence to regulations and to avoid the unequal treatment of clients or to control arbitrary managerial decisions (De Fuente et al., 1997, p. 207). On the other hand, a high level of formalization can lead to a context in which the work may be secure and familiar. This, in turn, can hinder the creation of new knowledge. However, new knowledge must be incorporated into organizational practices.

This practice can play a major part in the generation of knowledge because it permits the identification of problems, facilitates the transfer of knowledge (as it is easier to diffuse that which is standardized or formalized) and implies the institutionalization or codification of knowledge, and allowing tacit knowledge to become explicit. Thus, the cycle culminates in the creation of new knowledge.

Integration refers to the extent to which various subdivisions and employees of an organization communicate and work interrelated (Germain, 1996). Linking departments and divisions in the firm needs a set of mechanisms to coordinate activities and technologies inside the firm (Grant, 1996). It encourages people to demonstrate cooperative behaviors and facilitate the development of group rules or shared values. It can enhance diversity by encouraging employees to disperse a variety of mindsets and experiences across units and help them consider different perspectives (Brown and Eisenhardt, 1995).

In addition, organizational integration mechanisms can coordinate various departments and overcome cross-functional communication barriers to increase knowledge flow (Germain, 1996). Accordingly, an integrated structure assist knowledge management process by enabling employees to develop and create new knowledge and transform new or existing knowledge into new products or better decisions (Gold et al., 2001; Grant, 1996; Chen, 2010).

2.4.3.3 Cultural Knowledge Management Infrastructure

The cultural components could include firm’s vision and values, the attitudes toward learning, attitude toward knowledge transfer (through encouraging interaction) (Gold et al., 2001), and attitude toward innovativeness. It is considered as a key component to

knowledge management. Lee and Lee (2007), Kim et al. (2010), Chen (2007), and Chen (2010) empirically found that aspects of culture are positively related to knowledge management processes.

Organizational culture influences the adoption of knowledge management (Sanchez, 2004), and is one of the most significant hurdles of knowledge management effectiveness to overcome (Gold et al., 2001; Hinds and Aronson, 2002; H. Lee and Choi, 2000).

An important aspect of corporate culture is a shared vision (Gold et al., 2001; Leonard, 1995). Corporate vision should consist minimally of the future direction of the organization and organization's values as well as value statements. Trust and openness are commonly cited as two of these stated values that promote knowledge management behaviors (Zander and Kogut, 1995). This vision should be communicated by management and shared by the employees throughout the organization.

The second aspect of culture is interaction or collaboration. Interaction builds relationships and contacts that enable the sharing of different perspectives (Gold et al., 2001). Collaboration is important when attempting to transmit tacit knowledge between individuals or convert tacit knowledge into explicit knowledge (Gold et al., 2001; Nonaka and Takeuchi, 1995).

The third aspect is senior management support. Senior management support of knowledge practices within the organization is also vital to the cultural dimension (Gold et.al 2001). A portion of that support comes in the form of monitoring the knowledge within the organization so that errors can be noted and corrected (Davenport and Prusak, 1998).

Changes in corporate culture are also regarded as necessary for implementing knowledge management programs (Bhatt, 2001): “the ability of an organization to learn, develop memory, and share knowledge is [therefore] dependent on its culture’’ (Turban et al., 2005,p. 496). A knowledge-friendly culture is regarded as one of the most important factors impacting knowledge management and the outcomes from its use (Alavi et al., 2005-2006; Davenport et al., 1998). Organizational culture can influence the adoption of technology (Huang et al., 2003).

In Addition, if an organization’s culture is not appropriate for a knowledge project, no amount of technology, content, or project management skills will make the project successful (Davenport et al., 1998). In a study of 71 practitioners at a KM presentation, culture was perceived to be the biggest barrier to KM implementation (Mason and Pauleen, 2003). The process of exchanging knowledge between individuals and their environment takes place by using IT applications, which electronically distribute information between individuals from different organizations, and between individuals and external databases (Smith & Lyles, 2003, p. 110). Bock et al. (2005) examined knowledge sharing intentions through organizational climate. Climate, which was operationalized as fairness, affiliation, and innovativeness, was found to be a significant predictor of an employee’s intention to share knowledge (Bock et al., 2005).

2.4.4 Knowledge Management Processes Capability

Davenport et al. (1996) defined a business process as a set of activities with a start, finish, and identifiable outputs. These processes are knowledge processes when the activities are linked by knowledge, and surmised that all business processes are

fundamentally knowledge processes. However, Paisittanand et al. (2007, p. 85) defined the process capability as "the capability of a process to transform knowledge that is stored in the form of standard operating procedures and routines throughout the firm into valuable organizational knowledge, experience, and expertise".

Gold et al. (2001) noted that there are four fundamental business-process capabilities required for effective knowledge management: knowledge acquisition, knowledge conversion, and knowledge application. However, the process of knowledge sharing was not called-out as a separate variable in this study because it is addressed within the constructs of knowledge process capability (Gold et al., 2001). Chen et al. (2010) based on Moorman and Miner (1998), defined knowledge sharing as collective beliefs or behavioral routines that related to the spread of learning among individuals or units within an organization.

It is noticed here that Knowledge Sharing intersects with Knowledge Acquisition Process. With respect to Knowledge Creation process, Smith et al (2005) defined knowledge creation capability as the extent to which its organization's members have access to one another and other stakeholders, are capable of combining information and knowledge into new knowledge, and perceive value from the exchange and combination process. It is noticed here that Knowledge creation involves parts of Knowledge Acquisition, Conversion, and Application.

There are many knowledge processes perspectives in the literature as shown in table (1). The literature was concerned to discuss and investigate Gold's et al. processes.

Table 1: Knowledge Management Processes

Knowledge management process	Author
Generation, codification, and transferring	Ruggles (1998)
Conversion processes: socialization, externalization, combination, and internalization.	Nonaka and Takeuchi (1995)
Creation, validation, formatting, distribution, and application.	Bhatt (2001)
Creation, capturing, sharing, transferring, implementation, exploitation, and measuring.	Egbu, Gaskell, and Howes (2001)
Creating new, packaging and assembling, applying, and reuse and revalidation.	Tiwana (2002)
Knowledge acquisition, knowledge conversion, knowledge application, and knowledge protection.	Gold et al. (2001)

2.4.4.1 Knowledge Sources and Identification

What are the knowledge resources? How to identify the needed knowledge?

There are two knowledge types, external knowledge and internal knowledge. External is brought into a firm from the environment and is useful not only to a particular firm, but to their competitors in the marketplace. It can be traded in the market; it could be acquired through training or simply by hiring or buying it (Becker, 1962; Williamson, 1981). An example of external knowledge system is Competitive Intelligence (CI). CI is a process for gathering usable knowledge about the external business environment and turning it into the intelligence required for tactical or strategic decisions. Internal knowledge is an organization-specific knowledge that refers to the firm's particular modes of functioning and to its particular organizational context. It acts as organizational glue when the fast incorporation of external knowledge into a firm may threaten its cohesiveness and sense of unity and it is less prone to imitation.

Before engaging in the knowledge acquisition process, it is worthy to view a prerequisite stage called identification stage cited in Kraaijenbrink et al. (2006). This stage includes need identification, gap analysis, searching, viewing, and finding. Need identification is defined as finding out to a satisfying degree what knowledge an actor needs at a certain moment for a particular purpose. Closely related to need identification is gap analysis, which is defined as finding out what knowledge an actor is lacking at a certain moment for a particular purpose. However, looking whether knowledge is available internally before looking outside costs likely to be lower within an organization (cf. March, 1991; March & Simon, 1958).

Once there are indications for what knowledge is needed, companies can search for it. Therefore, a third subprocess that has been proposed is searching, which is defined as intentionally striving to find knowledge or sources of knowledge. This definition suggests that searching is an intentional process regardless of its outcome (cf. Marchionini, 1995). Together, these three subprocesses reflect an information seeking procedure. However, knowledge also can be identified without a focused searching process by broadly scanning the environment. Daft and Weick (1984) called this viewing. Daft and Weick did not provide a definition; Kraaijenbrink et al. (2006) defined it as monitoring the existing external knowledge base to detect relevant changes.

A final subprocess proposed in the identification stage is finding, which defined as coming across knowledge or across sources of knowledge. Finding is an outcome that can occur without searching or viewing, for example, when knowledge is pushed by another organization.

2.4.4.2 Knowledge Acquisition Process

Acquisition-oriented knowledge management processes are those oriented toward obtaining knowledge (Gold et al., 2001). Many forms describe acquisition processes: acquire, seek, generate, create, capture, and collaborate (Gold et al., 2001). The aspects of acquisition include accumulation of knowledge; innovation that is resulted from the creation of new knowledge from the application of existing knowledge and degree of experience in recognizing and capturing new knowledge (Gold et al.; Lee. C-P et al., 2007; Nahapiet and Ghoshal, 1998; Nonaka and Takeuchi, 1995); Improved use of existing knowledge as well as effectively acquiring new knowledge (Leonard-Barton, 1992).

Two examples of these processes are benchmarking and collaboration. Through benchmarking, an organization identifies outstanding practices from organizations (including itself), then assesses the current state of a particular process to identify gaps and problems (Zack, 1999a, 1999b), then organization can capture knowledge that is used internally (Gold et al., 2001; Marti, 2000). Through collaboration, knowledge sharing and dissemination and personal expertise guide to the creation of organizational knowledge (Gold et al., 2001). Two levels of collaboration take place between the individual and between the organization and its partners.

Kuhn and Beam (192) described three subprocesses within a Knowledge Integration Model that used to acquire knowledge. These subprocesses are communication, transaction, and cooperation. For example, by communication, knowledge is acquired by talking to somebody; by transaction, it is acquired by buying a document; and by cooperation, it is acquired by working together on a project. Other subprocesses could

be included are illegal activities, such as stealing and spying; and imitating a source's behavior or products (Zander & Kogut, 1995).

2.4.4.3 Knowledge Conversion

Conversion processes are those oriented toward making existing knowledge useful (Davenport et al., 1996; Gold et al., 2001; Verkasalo and Lappalainen, 1998). Gold et al. (2001) asserted that the processes to enable knowledge conversion include the firm's ability to integrate (Porter-Liebskind, 1996), organize (Davenport and Klahr, 1998; O'Dell and Grayson, 1998), combine structure, coordinate (Sanchez and Mahoney, 1996), or distribute knowledge (Davenport et al., 1996; Davenport et al., 1998; Zander and Kogut, 1995). Combining or integrating this knowledge reduces redundancy, enhances consistent representation, improves efficiency by eliminating excess volume (Davenport and Klahr, 1998; Grant, 1996), and replace knowledge that has become outdated (Gold et al., 2001). The knowledge must be structured and stored in a way that allows for searching, indexing, retrieving, and sharing so that it can be converted (Alavi and Leidner, 2001).

It has seen that the process of knowledge-conversion as a process of knowledge creation (Grant, 1996; Nonaka and Takeuchi, 1995). Armistead (1999) posited that the conversion process is a basic input–output knowledge-transformation process. The inputs (consisting of data, information, knowledge, customer knowledge, and embedded knowledge materials) are converted to produce the outputs (consisting of intellectual capital, enhanced knowledge, and knowledge embedded in products and customers), which in turn become inputs.

Nonaka and Takeuchi (1995) had different perspective for conversion process. They divided it into four processes: socialization, externalization, combination, and internalization.

Socialization: The process of sharing experiences, thereby creating tacit knowledge such as mental models and technical skills. Tacit knowledge can be obtained without the use of language, that is, through observation, imitation, and practice.

Externalization: The process of articulating tacit knowledge in the form of explicit concepts such as metaphors, analogies, hypotheses and models.

Combination: The process of systemizing concepts into a knowledge system by combining different bodies of explicit knowledge. Explicit knowledge is transferred through media such as documents, meetings, e-mail and phone conversations. Categorizing this knowledge can lead to the generation of new knowledge.

Internalization: The process of converting explicit knowledge to tacit knowledge and is closely related to learning by doing.

2.4.4.4 Knowledge Application

Knowledge-application processes are those oriented toward the actual use of the knowledge (Davenport et al., 1996; Gold et al., 2001; Verkasalo and Lappalainen, 1998). It includes the effective storage and retrieval mechanisms that enable a firm to access knowledge (Lee. ***C-P*** et al., 2007). Thus, apply knowledge to their products and services by various means such as repackaging available knowledge, training and motivating its people to think creatively, and utilizing people’s understanding of the company’s processes, and products and services.

Many organizations encourage organizational learning in which individuals and teams can apply the knowledge gained to initiatives’ such as new product development with

the aim of improved performance in areas such as ‘‘speed to market’’ and innovation (Sarin and McDermott, 2003). Droge et al. (2003, p.544) also argues that ‘‘in the long run, firms that create new knowledge at a lower cost and more speedily that competitors, and then apply that knowledge effectively and efficiently, will be successful at creating competitive advantage’’. Hence, knowledge utilization that acquired knowledge can be transformed from being a potential capability into a realized capability that impacts organizational performance (Cohen and Levinthal, 1990; Seleim and Khalil, 2007; Zahra and George, 2002).

2.4.4.5 Knowledge Protection

Security-oriented processes are those “designed to protect the knowledge within an organization from illegal or inappropriate use and theft” (Gold et al., 2001, p. 192). It is vital for a firm to generate and preserve a competitive advantage protect its knowledge (Porter-Liebskind, 1996). Protecting knowledge involves the use of technology; appropriate policies and procedures, use of copyright and patents, and use information technology systems that allow knowledge to be secured by filename, user name, password and file-sharing protocols that ascribe rights to authorized users (Lee and Yang, 2000).

An extensive review of the literature revealed that in the field of knowledge management, little discussion exists regarding the significance of knowledge protection (Porter-Liebskind, 1996; Gold et al., 2001). Knowledge Protection should be an integral part of the knowledge management process in alliances. As Choi and Lee (1997, pp. 52) observed, “the key issue in sustaining cooperative interorganizational relationships is how to integrate, transfer, and share knowledge more effectively, while at the same time protecting the rights of intellectual property and preventing partners from

exploiting joint assets without sharing the profits or other benefits generated by such assets".

Many protection mechanisms are used to protect intellectual property (IP) that used in Knowledge Management, these mechanisms include secrecy, restricted access to information, division of duties, circulation of staff between tasks, technical protection, documentation, effective staff loyalty-building strategies (PäällySaho and Jari Kuusisto, 2011).

Secrecy is defined in that Key Knowledge or know-how can simply be kept secret from some of the employees and/or from external collaborators, such as business partners or customers. Restricted access to information referred to restrict the number of people who have access to sensitive key information. In principle this method is somewhat similar to secrecy. Both of the two mechanisms may be facilitated by a structure in terms of centralization and low level of Integration.

Positive methods in personnel management can enhance employee motivation whereas negative and restrictive methods such as contracts and agreements may have quite opposite impacts (Kuusisto et al. 2005, cited in PäällySaho et al., 2011). Effective ways to maintain staff loyalty include financial incentives, training opportunities, or other occupational development related incentives. Enhancing the commitment of the personnel is a universal method as it can be used regardless of the sector and the size of the business. However, incentives for individual employees may discourage cooperation within the company as a result of increased internal competition (Holmström & Milgrom 1994). Organizations should also have the incentives to protect their innovations and keeping them from the competitors' reach can be essential for their survival (Simon et al., 2002).

Chapter Three: Research Methodology

3.1 Introduction

This chapter discusses the methodology of research that has been conducted. It includes variables' operational definitions. Also it includes main hypotheses that describe the relationship between the variables. In addition, this chapter describes the population has been chosen and the characteristic of participants that are supposed to guarantee a highly credible measurements. Finally, a description to the main statistical tools that were used to analyze the collected data.

3.2. The Operational Definitions

The operational definitions below were developed based on the literature review that was conducted for this research. The independent variables belong to KM infrastructure Capabilities, which include Interaction, Innovative Culture, Decentralization, Integration, and Technology. The dependent variables belong to KM Process Capabilities, which include Knowledge Acquisition Process Capability, Knowledge Conversion Process Capability, Knowledge Application Process Capability, and Knowledge Protection Process Capability.

- ***KM Infrastructure Capabilities:***

- **Interaction:** The general organizational knowledge-oriented culture should encourage knowledge practices that encourage employee interaction (Gold et al., 2001). Organizations should encourage employees participate in decision making, to ask others for assistance when needed, interact and discuss their work with other groups inside and outside organization (See Appendix I, Q24- Q28).

- **Innovative Culture** which reflects the perception that change and creativity are actively encouraged and rewarded, emphasizes learning, open information flows, and reasoned risk-taking (Bock, et al., 2005) (See Appendix I, Q29- Q31).

- **Decentralization** refers to the locus of decision making lying in the levels of hierarchical relationship. It is measured by the extent to which organization gives employees autonomy in decision making, participate in decision-making process, and search for problem solutions from all possible sources (See Appendix I, Q32- Q34). The Decentralization were adopted from Chen et al. (2010). They investigated centralization and they found that it affected the Knowledge Sharing and Creation Processes. in this study, Centralization were modified to measure the Decentralization instead of Centralization.

- **Integration** refers to the extent to which employees communicate among each other without restrictions, collaborate and share resources with each other without restrictions, and openess that facilitate interaction among organizational members and departments (Chen et al.,2010) (See Appendix I, Q35- Q37).

- **Technological Infrastructure** refers to the degree to which knowledge management is supported by the use of Technology. Many researchers have found that Technology is a crucial element for efficient knowledge processes (Davenport & Prusak, 1998; Gold et al., 2001) for the following reasons. Technology facilitates competition and partners monitoring, collaboration inside and outside the organization, searching, storage, and retrieve knowledge (Gold et al., 2000; Lee and Lee, 2007) (See Appendix I, Q38- Q42).

- ***Knowledge Management Process Capabilities***
- ***Knowledge Acquisition***: Knowledge acquisition includes business activities oriented toward obtaining knowledge (Gold et al., 2001).

  Two primary means for collecting knowledge are (1) to seek and acquire entirely new knowledge, or (2) create new knowledge through collaboration between individuals and between business partners (See Appendix I, Q1- Q7).

- ***Knowledge Conversion:*** Conversion processes are those oriented toward making available knowledge useful (Davenport et al., 1996; Gold et al., 2001; Verkasalo and Lappalainen, 1998). Gold et al. (2001) asserted that the processes to enable knowledge conversion include the firm's ability to integrate, organize, combine structure, coordinate, or distribute knowledge (See Appendix I, Q8- Q12).

- ***Knowledge Application:*** Knowledge Application Processes are those oriented toward the actual use of the knowledge (Davenport et al., 1996; Gold et al., 2001; Verkasalo and Lappalainen, 1998). This knowledge can be used to adjust strategic direction, solve new problems, and improve efficiency. Lee et al. (2007) opertionalized the knowledge application as the effective storage and retrieval mechanisms that enable a firm to access knowledge (See Appendix I, Q13- Q17).

- ***Knowledge Protection:*** Security-oriented knowledge management processes are those designed to protect the firm's knowledge from illegal or inappropriate use or theft (Gold et al., 2001). Protection mechanisms include technology infrastructure, governing the behavior and conducting of employees, and use incentives (See Appendix I, Q18- Q23).

Many protection mechanisms are used to protect intellectual property (IP) that used in Knowledge Management. These mechanisms include secrecy, restricted access to information, and technical protection. These mechanisms are proposed to be affected by the decentralized and integrated structure and technological infrastructure (Päällysaho and Kuusisto, 2011).

3.3 Hypotheses

There are four main hypotheses proposed to investigate the nature of relationship between KM Infrastructure Capabilities and KM Process Capabilities.

H0.1: There is no significant relationship between **KM Infrastructure Capabilities** and Knowledge **Acquisition** Processes capability.

H0.2: There is no significant relationship between **KM Infrastructure Capabilities** and Knowledge **Conversion** Process capability.

H0.3: There is no significant relationship between **KM Infrastructure Capabilities** and Knowledge **Application** Process capability.

H0.4: There is no significant relationship between **KM Infrastructure Capabilities** and Knowledge **Protection** Process capability.

3.4 Research Type and Scale

The research type is cross-sectional in which data were collected only once. In this research, quantitative approaches were used for data collection. The questionnaire was used in this empirical work for exploring and gathering the relevant information to answer the research questions. It is represented by using the 5-points Likert scale, where

1 represents “Never”, 2 represents “Rarely”, 3 represents “Sometimes”, 4 represents “mostly”, and finally 5 represents “Always”.

3.5 Population of Study

The population in this research was pharmaceutical manufacturing companies operating in Jordan. Table (2) shows the targeted companies and the participated ones. Twenty-one out of twenty-six companies participated in the survay. Therefore, the data collection was based on a complete census of the population that included knowledge workers. The unit of analysis is knowledge workers. These knowledge workers hold positions at the top level, middle level (i.e Head of Divisions), low level (i.e head of departments and supervisors), and employees. Employees were targeted who enjoyed the following characteristics: a) employees who are involved in the daily flow of information and knowledge who use information technology as a communication medium; b) Engineers and pharmacists who have a professional/academic administrative qualification.

Table 2: Participated companies list

No	Company Name
1	DADVET
2	Nutri Dar
3	Dar Al Dawa
4	Arab Center Co. for Pharmaceuticals & Chemicals
5	Philadelphia Pharmaceutical Co.
6	Hayat Pharmaceutical Industries Co. Ltd.
7	Hikma Pharmaceuticals,
8	Jordan Sweden Medical and Sterilization Co. (JOSWE)
9	Jordanian Pharmaceutical Manufacturing Co. Ltd
10	Amman Pharmaceutical Industries Co. (API)
11	Pharma International Co
12	3R Pharmaceuticals & Cosmatics Industries Co.Ltd
13	The Arab Pharmaceutical Manufacturing Co. LTD (APM)
14	The United Pharmaceutical Manufacturing Co. Ltd
15	Jerash Pharmaceutical Manufacturing
16	Triumpharma Drug Delivery Innovations
17	AraGen Biotechnology
18	Tabouk Pharmaceutical Manufacturing Company
19	International Pharmaceutical Research Center
20	Jordanian Center for Pharmaceutical Research
21	The Arab Investment Company

3.6 Data Collection Methods

In this research, two types of data were used to achieve the study objectives:

3.6.1 Secondary Data

There were several sources of secondary data, for research purpose, the researcher used books, research articles, and specialized websites. The specialized websites were used to collect data about the companies, specifically, Amman Chamber of Industry website. In addition, it was used to collect research articles from the university e-library (Ex, www.aci.org.jo; www.ezlibrary.ju.edu.jo).

3.6.2 Primary Data

Primary data means the data that is collected from the population for the first time. The communicating process between the researcher and the pharmaceutical companies was firstly conducted by the telephone. The researcher called the human resource department in each company to invite them to participate in the study. After explaining the purpose of the study, the researcher clarified who is to be targeted according to the population's characteristics have been mentioned above. The researcher asked which method of delivering the companies prefer. Most of the companies preferred the questionnaires to be delivered manually, but few of them requested it with the E-mail to facilitate the data collection process. The questionnaire package included a cover letter that included the aim of study, the targeted sector, and an obligation regarding data confidentiality and delivering a result report. The package was in Arabic Language (native language in Jordan) to ensure that all the participants perceive the same meaning even if the educational level or years of experience are different among employees.

After distributing the questionnaires, a four to seven week timeframe was allotted for each respondent to reply. A weekly follow up used either by an e-mail or by a telephone reminder. Other companies needed a daily follow up just to know whether they accepted participation in the study or not. The data collection method was chosen on the basis of many factors such as cost, time, and respondent's preference in which how they prefer to receive and deliver the questionnair. Data collection stage took seven weeks. The period of data collection, distribution methods, and collection methods were estimated to ensure that the maximum number of participants were participated in the study.

3.7 Data Analysis Techniques

Descriptive statistics (means, frequencies, and standard deviation) were used to describe the characteristics of the respondents and to identify the extent to which the study's variables existed in the pharmaceutical manufacturing companies operating in Jordan. Inferential statistics used to test the study's hypotheses through employing multiple regression analysis.

Chapter Four: Data Analysis

4.1 Introduction

The aim of this chapter is to present the results of analyzing the collected primary data for the purpose of achieving the study's objectives. Firstly, the characteristics of the respondents are presented. Then, investigating the relationship between KM Infrastructure Capabilities and KM Process Capabilities as well as investigating the extent to which they exit in the Pharmaceutical manufacturing companies operating in Jordan.

4.2 companies' Respondents Characteristics

A total of 203 out of 245 questionnaires were collected. The response rate was eighty percent. Demographic items are those that provide information about the organizations in which the respondents completed the questionnaires. The demographic items that were investigated in this research are: Size of the Company (in terms of number of employees), age of the company, respondents' positions, respondents' experiences (in terms of number of experience years), and respondents' educational levels. The population's characteristics are demonstrated in table (3).

We notice that 60.6% of participants belong to Large Companies that have more than 130 employees. This implies that we have a semi adequate between the number of participants from large companies and small companies (less than or equal 130) that decreased the bias in the results. 98% of participants belong to companies that have age more than 5 years. This implies that new entrants in the past 5 years are very small, this can be explained in that pharmaceutical companies work in knowledge intensive industry, thus, they need to have prior knowledge in order to accumulate and exploit their knowledge.

Table 3: Demographic data descriptive

Demographical Dimensions	Category	Frequency	Percent
Company Size (Number of employees)	Less Than 40	13	6.4
	Between 40 and less than 70	30	14.8
	Between 70 and Less Than 100	26	12.8
	Between 100 and less than 130	11	5.4
	More than 130	123	60.6
Company Age (Years)	Less Than 5	4	2.0
	Between 5 and less than 9	11	5.4
	Between 10 and Less Than 14	26	12.8
	Between 15 and less than 19	37	18.2
	Between 19 and less than 24	27	13.3
	More Than 25	98	48.3
Managerial position	Executive Managers	13	6.4
	Divisional Managers	17	8.4
	Section Heads	90	44.3
	Supervisors	29	14.3
	Employees	54	26.6
Educational level	High School	4	2.0
	Diploma	31	15.3
	Bachelors	125	61.6
	Master	39	19.2
	Doctoral	4	2.0
Experience Level (Years)	Less Than 5	53	26.1
	Between 5 and less than 9	54	26.6
	Between 10 and Less Than 14	54	26.6
	Between 15 and less than 19	22	10.8
	More than 20	20	9.9
Total		203	100%

Also, 85.22% of participants hold positions (Section Heads, Supervisors, and employees). 84.7% of participants have Bachelors, Master, and Doctoral degrees. 64% of participants have years of experience between 5 and 19 years. This implies that the majority of participants have mixed knowledge in the technical work and managerial

duties, high number of years of experience and well educated, this ensure their engagement in the daily processes which are considered as a source of internal knowledge, ensure that they have the prior knowledge and experience that facilitates knowledge accumulation, transfer, and application.

4.3 Validity and Reliability

4.3.1 Validity

Three validity types were examined in the study, content validity, face validity, and internal validity.

Content validity: Content validity is based on the extent to which a measurement reflects the specific intended domain of content (Carmines & Zeller, 1991). The first step the researcher relied upon in enhancing the validity of the scale was to benefit from a pre-used scale that is developed from other researchers. The items used in the scale were gathered from various scales developed from researches with similar interest.

Face Validity: Content validity is solely not enough to ensure validity. Some scales may be understood in one country and not in another. In addition, even if it is understood by the respondents, the wording of the questionnaire may play an important role in maximizing the accuracy and objectivity of the respondents answers. To avoid such problems, the instrument went through an intensive review and analysis with proficient personnel (academics) back and forth to ensure its validity. The first step in reviewing the construct that questionnaire was reviewed by four academics. During this step, a set of items were deleted and filtered for the redundancy reason. After that, a translation from English to Arabic was conducted. For the next time, those proficient reviewed both questionnaires to check whether the translated questionnaire is understandable or not. The researcher distributed the questionnaire in Arabic language

only to insure that all the participants perceived the same meaning in their native language.

Internal validity: Correlation matrixes were used to determine the level of internal validity. To ensure that items are measuring the same variable (construct), they must be correlated with each other. The closer the values are to 1 the more highly correlated the items are. It has been noticed that most of the values are above 0.35 which indicates a positive correlation between items. This leads to a higher level of internal validity.

There are nine variables in this study, five independent and four dependent. The correlation matrixes of each variable are shown in tables (4,5,6,7,8,9,10,11,12) as follow:

Table 4: Knowledge Acquisition Process correlation matrix

	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7
AQ1	1						
AQ2	.585**	1					
AQ3	.483**	.552**	1				
AQ4	.393**	.404**	.467**	1			
AQ5	.552**	.439**	.548**	.358**	1		
AQ6	.469**	.548**	.550**	.394**	.588**	1	
AQ7	.386**	.624**	.518**	.462**	.350**	.555**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5: Knowledge Conversion Process correlation matrix

	CON1	CON2	CON3	CON4	CON5
CON1	1				
CON2	.807**	1			
CON3	.750**	.769**	1		
CON4	.616**	.649**	.696**	1	
CON5	.703**	.627**	.686**	.748**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6: Knowledge Application Process correlation matrix

	APL1	APL2	APL3	APL4	APL5
APL1	1				
APL2	.575**	1			
APL3	.582**	.597**	1		
APL4	.589**	.494**	.646**	1	
APL5	.450**	.508**	.588**	.625**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7: Knowledge Protection Process correlation matrix

	PRO1	PRO2	PRO3	PRO4	PRO5	PRO6
PRO1	1					
PRO2	.700**	1				
PRO3	.648**	.594**	1			
PRO4	.581**	.629**	.575**	1		
PRO5	.480**	.539**	.477**	.501**	1	
PRO6	.495**	.490**	.586**	.610**	.547**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 8: Interaction correlation matrix

	Cult1	Cult2	Cult3	Cult4	Cult5
Cult1	1				
Cult2	.609**	1			
Cult3	.698**	.614**	1		
Cult4	.684**	.612**	.746**	1	
Cult5	.566**	.547**	.664**	.666**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 9: Innovative Culture correlation matrix

	Cult6	Cult7	Cult8
Cult6	1		
Cult7	.635**	1	
Cult8	.706**	.710**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10: Decentralization correlation matrix

	Struct1	Struct2	Struct3
Struct1	1		
Struct2	.717**	1	
Struct3	.558**	.581**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 11: Integration correlation matrix

	Struct4	Struct5	Struct6
Struct4	1		
Struct5	.792**	1	
Struct6	.645**	.716**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 12: Technological Infrastructure correlation matrix

	Tech1	Tech2	Tech3	Tech4	Tech5
Tech1	1				
Tech2	.540**	1			
Tech3	.507**	.614**	1		
Tech4	.441**	.571**	.628**	1	
Tech5	.543**	.622**	.663**	.646**	1

**. Correlation is significant at the 0.01 level (2-tailed).

4.3.2 Reliability

Reliability is the degree to which an instrument measures the same way each time it is used under the same conditions with the same subjects. That is, reliability refers to the accuracy (consistency and stability) of measurement by the instrument or repeatability of an assessment over a variety of conditions. Variables with composite measures were evaluated for their internal consistency through the Cronbach's Alpha measure. While increasing the value of alpha is partially dependent upon the number of items in the scale, it should be noted that this has decreasing returns.

The higher the Cronbach's Alpha value, the greater is the internal consistency of the items making up a composite ensure (Litwin, 1995). George and Mallery (2003) provide the following rules of thumb: "≥ .9 – Excellent, ≥ .8 – Good, ≥ .7 – Acceptable, ≥ .6 –Questionable, ≥ .5 – Poor, and < .5 – Unacceptable" (p. 231).

Table (13) shows that all the variables have coefficients greater than 0.7. This indicates that all the variables are reliable.

Table 13: Cronbach's alpha coefficient

Variable	Cronbach's alpha coefficient
Technological Infrastructure (5 items)	0.873
Integration (3 items)	.0.7
Decentralization (3 items)	.829
Innovativeness (3 items)	.866
Interaction (5 items)	0.9
Knowledge Acquisition (7 items)	0.868
Knowledge Conversion (5 items)	0.922
Knowledge Application (5)	0.866
Knowledge Protection (6 items)	0.883

4.4 Descriptive Analysis

In this section, the extent of applying Knowledge Management Infrastructure Capabilities and Knowledge Management Process Capabilities in the Pharmaceutical sector in Jordan will be presented through their mean scores. Data analysis results showed that KM Infrastructure Capabilities are applied to a good extent in the pharmaceutical manufacturing companies. KM Infrastructure Capabilities mean score is 3.559 Which exceeds the average mean midpoint 3.0 (see Table 15 which shows the KM Infrastructure Capabilities mean score ordered from the highest value to the lowest value).

In particular, the mean score of Technology is 3.8537 which is the highest value among KM Infrastructural Capabilities. The investment in Information Technology that enables knowledge storage and retrieval, and communication internally and externally has been indicated in the literature as an important enabler (Handzic, 2011; Lee et al., 2007) that facilitates Knowledge Management Processes (Anderson, 2009; Davenport & Prusak, 1998). The Cultural dimensions that are included in this study (Interaction and Innovative Culture) have mean score values equal to 3.499 and 3.47, respectively. This indicates the nature of pharmaceutical manufacturing company's culture where

employees interact with each other to solve problems and discuss their work, and are encouraged to take risk and to share in decision-making process.

Decentralization and Integration have mean scores equal to 3.355 and 3.617, respectively. The highly competitive and dynamic environment of the pharmaceutical industry, and the need for innovation (Horrobin, 2001; Montes et al., 2004), might explain the above average existence of Decentralization and Integration (Chen et al., 2010).

Regarding the extent to which pharmaceutical manufacturing companies apply KM Processes, the research shows that the four KM Process Capabilities have average scores above the midpoint 3.0 as follows: 3.686 for the Knowledge Acquisition, 3.412 for Knowledge Conversion, 3.776 for Knowledge Application, and 3.727 for Knowledge Protection (see table 15 that shows KM Process Capabilities were ordered from the highest to the lowest value).

We notice that Pharmaceutical manufacturing companies apply Knowledge Acquisition Process to a good extent. They collect knowledge by seeking and acquiring entirely new knowledge, or by creating new knowledge through collaboration between individuals and between business partners. In order to use the acquired knowledge, it should be prepared first. Pharmaceutical manufacturing companies apply Knowledge Conversion Process to a good extent by applying a set of practices aims to transform newly acquired knowledge into action plans, new products, or enhanced efficiency.

Once the knowledge is converted, it is applied and it needs to be protected. Knowledge Application and Protection processes had the highest scores 3.776, 3.727, respectively, which emphasizes the need to exploit and apply knowledge in the form of new products, improved efficiency, decisions, as well as protect the resulting knowledge (Gold et al., 2001; Porter-Liebskind, 1996, Cohen and Levinthal, 1990; Zahra and George, 2002).

Table 14: KM Infrastructure Capabilities Mean Scores

	Mean
Technology	3.8537
Integration	3.6174
Interaction	3.4989
Innovative	3.4696
Decentralization	3.3547

Table 15: KM Process Capabilities Mean Scores

	Mean
Application	3.7762
Protection	3.7271
Acquisition	3.6861
Conversion	3.4124

4.5 Inferential Statistics: Hypotheses Testing Results

Hypotheses testing involves testing the null hypotheses (denoted by H0) which are assumed to be true but tested for possible rejection. The probability value (p-value) obtained from the statistical hypotheses test is considered the decision rule for rejecting the null hypotheses (Creswell, 2003). If the p-value is less than or equal to a predetermined level of significance (α- level), the null hypothesis will be rejected and the alternative hypothesis will be supported. By contrast, if the p-value is greater than

the α-level, the null hypothesis cannot be rejected and no support will be claimed for the alternative hypothesis.

Main hypothesis of the study and the sub-hypotheses will be tested to determine whether KM Infrastructure Capabilities variables have a statistically significant effect on Knowledge Management Process Capabilities. In this regard, we will use multiple regression technique. It is defined as “a method of analysis for assessing the strength of the relationship between each of a set of explanatory variables (sometimes known as independent variables, although this is not recommended since the variables are often correlated), and a single response (or dependent) variable” (Landau and Everitt 2004, p.101). The model fit will be tested by the model summary of the multiple-regression and the analysis of variance (ANOVA).

Four main hypotheses were suggested to investigate the relationship between the KM Infrastructure Capabilities and KM Process Capabilities. The four main hypotheses were proposed based on the four KM Processes: Knowledge Acquisition Process Capability, Knowledge Conversion Process Capability, Knowledge Application Process Capability, and Knowledge Protection Process Capability. Therefore, the required analysis will be applied four times based on each dependent variable.

4.5.1 Knowledge Acquisition Process Hypothesis Test:

The first main hypothesis linked the KM infrastructure Capabilities with Knowledge Acquisition Process Capability as follows:

H0.1: ***There is no significant relationship between KM Infrastructure Capabilities (Technology, Interaction, Innovative Culture, Decentralization, and Integration) and Knowledge Acquisition Processes Capability.***

The results of testing of the main hypothesis are demonstrated in tables (16,17) as following:

Table 16: Acquisition- KM Infrastructure Capabilities Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.712[a]	.506	.494	.51530

a. Predictors: (Constant), Integration, Technology, Interaction, Decentralization, Innovative

Table 17: Acquisition-KM Infrastructure Capabilities ANOVA Test

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	53.388	5	10.678	40.212	.000[a]
Residual	52.045	196	.266		
Total	105.433	201			

a. Predictors: (Constant), Integration, Technology, Decentralization, Interaction, Innovative
b. Dependent Variable: Acquisition

The analysis of variance (ANOVA) allows us to statistically test the main null hypothesis. Looking at the ANOVA analysis we would conclude that the F-ratio for these data is 40.212 which is significant at $p<0.05$ (Alpha in this case equals sig=.000). This result tells us that there is less than a 0.05% chance that an F-ratio of this value would happen by chance alone. Therefore, we conclude that there is a statistically significant effect of KM Infrastructure capabilities (at least one of the variables) on Knowledge Acquisition and thus reject the null hypothesis and accept the alternative hypothesis.

The multiple correlation coefficient $R = 0.712$ indicates that there is a strong positive relationship between KM Infrastructure Capabilities (Technology, Interaction, Innovative Culture, Decentralization, and Integration) and Knowledge Acquisition

Process Capability. This means that the independent variables and dependent variable change in the same direction.

The multiple correlation coefficient is a gauge of how well the model predicts the observed data. The value of R^2=0.506 indicates the amount of variations in Knowledge Acquisition Process variable that is accounted by Knowledge Management Infrastructure Capabilities. It plots that 50.6% of the variability of Knowledge Acquisition Process has been explained by the KM Infrastructure Capabilities variables. It also means that the higher the KM Infrastructure Capabilities applicability, the higher the applicability of Knowledge Acquisition Process Capability.

The adjusted R^2 tells us about the generalizability of the model. It allows us to generalize the results taken from the respondents to the whole population. In this case it equals 0.494. It is noticed that the adjusted R^2 has almost the same value as R^2. If we exclude the adjusted R^2 from R^2 (0.506-0.494= 0.012) we have a value of 0.012. The 0.012 shrinkage means that if the model has been fitted when the whole population participates rather than those responded in the study, there will be 1.2% less variance in the outcome.

- **The Effect of Predictors**

The other part of multiple regression analysis is concerned with testing the effect of each predictor included in the model (that is beta β) on the dependent variable. By using the value of β and α significance level, we can infer the acceptability of each of the sub-hypothesis and the extent of application of each predictor. In other words, we can identify the most KM infrastructure Capabilities that influence the dependent variable.

Table 18: Acquisition-KM Infrastructure Capabilities coefficients of predictors

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.227	.198		6.191	.000		
Technology	.267	.055	.302	4.862	.000	.652	1.533
Interaction	.272	.076	.326	3.592	.000	.306	3.271
Innovative	.144	.069	.191	2.077	.039	.298	3.350
Decentralization	.034	.071	.042	.481	.631	.332	3.014
Integration	-.037	.051	-.047	-.725	.469	.592	1.688

a. Dependent Variable: Acquisition

The β (standardized coefficient) indicates the individual contribution of each predictor (variable) to the model if all other predictors are held constant. Table (18) shows the standardized coefficients for each Infrastructural dimension. For Interaction, Innovative Culture, and Technology the value of β equals 0.326, 0.191, and 0.302 respectively- they are positive and relatively high. The level of effect of these variables depends on the β value, the higher β value the higher effect on dependent variable. Therefore, the Interaction, Technology, and Innovative Culture respectively affect the level of Knowledge Acquisition Process. While the Decentralization and Integration have very small β values equal to 0.042 and -.047. On the other hand, these values do not contribute in explanation the effect of KM Infrastructure on Knowledge Acquisition Process due to the insignificance level they have.

According to the sub-hypothesis testing rule has been discussed above, the testing results are illustrated in table (19).

Table 19: Acquisition-KM Infrastructure Capabilities influential factors

Null Sub-hypothesis	**Result**
H0.1.1: There is no significant relationship between **Technology** and Knowledge **Acquisition** Processes Capability.	**Affects**
H0.1.2: There is no significant relationship between **Interaction** and Knowledge **Acquisition** Processes Capability	**Affects**
H0.1.3: There is no significant relationship between **Innovative Culture** and Knowledge **Acquisition** Processes Capability	**Affects**
H0.1.4: There is no significant relationship between **Decentralization** and Knowledge **Acquisition** Processes Capability	**Doesn't Affect**
H0.1.5: There is no significant relationship between **Integration** and Knowledge **Acquisition** Processes Capability	**Doesn't Affect**

Note: If the sub-hypothesis is rejected at significance level lower than 0.05, then the independent variable **Affects** the dependent variable. If not, then the independent variable doesn't **Affect** the dependent.

4.5.2. The Knowledge Conversion Process Hypothesis Test

The second main hypothesis linked the KM infrastructure Capabilities with Knowledge Conversion Process Capability as follows:

H0.2: ***There is no statistically significant relationship between KM Infrastructure Capability (Technology, Interaction, Innovative Culture, Decentralization, and Integration) and Knowledge Conversion Processes Capability.***

The results of testing of the main hypothesis are demonstrated in tables (20, 21) as following:

Table 20: Conversion-KM Infrastructure Capabilities Model Summary

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.747[a]	.558	.547	.61777

a. Predictors: (Constant), Integration, Technology, Decentralization, Innovative, Interaction

Table 21: Conversion-KM Infrastructure Capabilities ANOVA TEST

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	94.552	5	18.910	49.550	.000[a]
Residual	74.802	196	.382		
Total	169.354	201			

a. Predictors: (Constant), Integration, Technology, Decentralization, Innovative, Interaction
b. Dependent Variable: Conversion

Looking at the ANOVA analysis we would conclude that the F-ratio for these data is 49.550 which is significant at $p<0.05$ (Alpha in this case equals sig=.000). Therefore, we conclude that there is a statistically significant effect of KM Infrastructure capabilities (at least one of the variables) on Knowledge Conversion Process Capability and thus reject the null hypothesis and accept the alternative hypothesis.

The multiple correlation coefficient R = 0.747 indicates that there is a strong positive Correlation between KM Infrastructure (Technology, Interaction, Innovative Culture, Decentralization, and Integration) and Knowledge Conversion Process. The value of R^2=0.558 indicates the amount of variations in Knowledge Conversion Process variable that is accounted by the fitted model. It plots that 55.8% of the variability of Knowledge Conversion Process has been explained by the KM Infrastructure capabilities variables. It also means that the higher the KM Infrastructure capabilities applicability, the higher the applicability of Knowledge Conversion Process. The adjusted R^2 equals 0.547. The shrinkage equal 0.011 shrinkage.

Table 22: Conversion- KM Infrastructure coefficients of predictors

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Err	Beta			Tolerance	VIF
(Constant)	.220	.239		.921	.358		
Technology	.304	.066	.271	4.617	.000	.656	1.525
Interaction	.577	.091	.545	6.345	.000	.306	3.272
Innovative	.056	.081	.059	.692	.490	.311	3.215
Decentralization	.006	.083	.005	.066	.947	.344	2.904
Integration	-.058	.061	-.058	-.944	.346	.597	1.675

a. Dependent Variable: Conversion

- **The Effect of Predictors**

For Interaction and Technology the value of β equals 0.545 and 0.271 respectively- they are significant, positive, and relatively high. While Innovative Culture, Decentralization, and Integration have very small β value equals to 0.059, 0.005, and -0.058.

Table 23: KM Infrastructure-Application influential factors

Null Sub-hypothesis	Result
H0.2.1: There is no significant relationship between **Technology** and Knowledge **Conversion** Processes Capability.	**Affects**
H0.2.2: There is no significant relationship between **Interaction** and Knowledge **Conversion** Processes Capability	**Affects**
H0.2.3: There is no significant relationship between **Innovative Culture** and Knowledge **Conversion** Processes Capability	**Affects**
H0.2.4: There is no significant relationship between **Decentralization** and Knowledge **Conversion** Processes Capability	Doesn't **Affect**
H0.2.5: There is no significant relationship between **Integration** and Knowledge **Conversion** Processes Capability.	Doesn't **Affects**

Note: If the sub-hypothesis is rejected at significance level lower than 0.05, then the independent variable **Affects** the dependent variable. If not, then the independent variable doesn't **Affect** the dependent.

On the other hand, these values don't contribute in explanation the effect of KM Infrastructure on Knowledge Conversion Process due to the insignificance level they have. According to the sub-hypothesis testing rule has been discussed above, the testing results are illustrated in table (23).

4.5.3 The Knowledge Application Process Hypothesis Test:

The third main hypothesis linked the KM infrastructure Capabilities with Knowledge Application Process Capability as follows:

H0.3: ***There is no statistically significant relationship between KM Infrastructure Capabilities (Technology, Interaction, Innovative Culture, Decentralization, and Integration) and Knowledge Application processes capability.***

The results of testing of the main hypothesis are demonstrated in tables (24, 25) as following:

Table 24: Application-KM Infrastructure Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.758[a]	.575	.564	.48198

a. Predictors: (Constant), Integration, Technology, Decentralization, Innovative, Interaction

Table 25: Application-Infrastructure ANOVA TEST

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	61.519	5	12.304		
Residual	45.532	196	.232	52.964	.000[a]
Total	107.051	201			

a. Predictors: (Constant), Integration, Technology, Decentralization, Innovative, Interaction
b. Dependent Variable: Application

Looking at the ANOVA analysis we would conclude that the F-ratio for these data is 52.964 which is significant at $p<0.05$ (Alpha in this case equals sig=.000). Therefore, we conclude that there is a statistically significant effect of KM Infrastructure capabilities (at least one of the variables) on Knowledge Application and thus reject the null hypothesis and accept the alternative hypothesis.

The multiple correlation coefficient R = 0.758 indicates that there is a strong positive relationship between KM Infrastructure (Technology, Interaction, Innovative Culture,

Decentralization, and Integration) and Knowledge Application Process Capability. Looking at the ANOVA analysis we would conclude that the F-ratio for these data is 52.964 which is significant at $p<0.05$ (Alpha in this case equals sig=.000). Therefore, we conclude that there is a statistically significant effect of KM Infrastructure capabilities (at least one of the variables) on Knowledge Application and thus reject the null hypothesis and accept the alternative hypothesis. The value of $R^2=0.575$ indicates the amount of variations in Knowledge Application Process variable that is accounted by the fitted model. It plots that 57.5% of the variability of Knowledge Application Process Capability has been explained by the KM Infrastructure capabilities variables. The adjusted R^2 equals 0.564and the shrinkage equal 0.011.

Table 26: Application-Infrastructure coefficients predictors

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.047	.186		5.621	.000		
Technology	.334	.051	.374	6.504	.000	.656	1.525
Interaction	.210	.071	.249	2.956	.003	.306	3.272
Innovative	.180	.063	.236	2.831	.005	.311	3.215
Decentralization	.008	.065	.010	.124	.901	.344	2.904
Integration	.017	.048	.021	.351	.726	.597	1.675

a. Dependent Variable: Application

- **The Effect of Predictors**

For Interaction, Innovative Culture, and Technology the value of β equals 0.249, 0.236, and 0.374 respectively- they are positive and relatively high. While Decentralization and Integration have very small β value equals to 0.01 and 0.021. On the other hand, these values don't contribute in explanation the effect of KM Infrastructure on Knowledge Application Process due to the insignificance level they have. According to

the sub-hypothesis testing rule has been discussed above, the testing results are illustrated in table (27).

Table 27: KM Infrastructure-Application influential factors

Null Sub-hypothesis	**Result**
H0.3.1: There is no significant relationship between **Technology** and Knowledge **Application** Processes Capability.	**Affects**
H0.3.2: There is no significant relationship between **Interaction** and Knowledge **Application** Processes Capability	**Affects**
H0.3.3: There is no significant relationship between **Innovative Culture** and Knowledge **Application** Processes Capability	**Doesn't Affect**
H0.3.4: There is no significant relationship between **Decentralization** and Knowledge **Application** Processes Capability	**Doesn't Affect**
H0.3.5: There is no significant relationship between **Integration** and Knowledge **Application** Processes Capability.	**Doesn't Affect**

Note: If the sub-hypothesis is rejected at significance level lower than 0.05, then the independent variable **Affects** the dependent variable. If not, then the independent variable doesn't **Affects** the dependent variable.

4.5.4 Knowledge Protection Process:

The first main hypothesis linked the KM infrastructure Capabilities with Knowledge Protection Process Capability as follows:

H0.4: ***There is no statistically significant relationship between KM Infrastructure Capability (Technology, Interaction, Innovative Culture, Decentralization, and Integration) and Knowledge Protection Processes Capability.***

The results of testing of the main hypothesis are demonstrated in tables (28, 29) as following:

Table 28: Protection-KM Infrastructure Capability Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.669[a]	.447	.433	.63768

a. Predictors: (Constant), Integration, Technology, Decentralization, Innovative, Interaction

Table 29: Protection-KM Infrastructure Capability ANOVA TEST

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	64.808	5	12.962	31.876	.000[a]
Residual	80.106	197	.407		
Total	144.914	202			

a. Predictors: Constant, Integration, Technology, Decentralization, Innovative, Interaction

b. Dependent Variable: Protection

Looking at the ANOVA analysis we would conclude that the F-ratio for these data is 52.964 which is significant at $p<0.05$ (Alpha in this case equals sig=.000). Therefore, we conclude that there is a statistically significant effect of KM Infrastructure capabilities (at least one of the variables) on Knowledge Protection and thus reject the null hypothesis and accept the alternative hypothesis.

The multiple correlation coefficient $R = 0.669$ indicates that there is a strong positive Correlation between KM Infrastructure Capabilities (Technology, Interaction, Innovative Culture, Decentralization, and Integration) and Knowledge Protection Process Capability. The value of $R^2=0.447$ indicates the amount of variations in Knowledge Protection Process variable that is accounted by the fitted model. It plots that 44.7% of the variability of Knowledge Protection Process has been explained by the KM Infrastructure Capabilities variables. The adjusted R^2 equals 0.433 and the shrinkage equals 0.014.

Table 30: Protection-KM Infrastructure Capabilities coefficients of predictors

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.944	.245		3.852	.000		
Technology	.427	.068	.412	6.289	.000	.653	1.533
Interaction	.148	.094	.151	1.576	.117	.305	3.273
Innovative	.216	.084	.246	2.579	.011	.309	3.239
Decentralization	-.084	.086	-.088	-.974	.331	.342	2.920
Integration	.042	.063	.046	.662	.509	.593	1.687

a. Dependent Variable: Protection

- **The Effect of Predictors**

For Innovative Culture and Technology the value of β equals 0.246 and 0.412 respectively- they are positive and relatively high. While Interaction, Decentralization, and Integration have very small β value equals to 0.151, -0.088, and 0.046. On the other hand, these values do not contribute in explanation the effect of KM Infrastructure on Knowledge Protection Process due to the insignificance level they have. The results of sub-hypothesis are shown in table (31).

Table 31: Protection-KM Infrastructure Capabilities influential factors

Null Sub-hypothesis	**Result**
H0.4.1: There is no significant relationship between **Technology** and Knowledge **Protection** Processes Capability	**Affects**
H0.4.2: There is no significant relationship between **Interaction** and Knowledge **Protection** Processes Capability	**Doesn't Affects**
H0.4.3: There is no significant relationship between **Innovative Culture** and Knowledge **Protection** Processes Capability	**Affects**
H0.4.4: There is no significant relationship between **Decentralization** and Knowledge **Protection** Processes Capability	**Doesn't Affects**
H0.4.5: There is no significant relationship between **Integration** and Knowledge **Protection** Processes Capability	**Doesn't Affects**

Note: If the sub-hypothesis is rejected at significance level lower than 0.05, then the independent variable **Affects** the dependent variable. If not, then the independent variable doesn't **Affect** the dependent variables.

4.5.5 Multiple-Regression Assumption Test

Valid main hypothesis test and sub-hypothesis test depended on the regression assumptions. An important assumption is the ***multicollinearity.*** Multicollinearity exists when there is a strong correlation between two or more independent variables in the regression model (Field, 2004). Perfect collinearity exists when one of the independent variables (or more) has a perfect linear correlation with others. It means that if we have two independent variables that are perfectly correlated, the β of each variable is interchangeable, this leads to a biased regression model where one or more of the independent variables that may have statistically significant effect on the dependent variable are incorrectly rejected and excluded from the model (type II error).

Various statistical tools can identify multicollinearity. Two measures were used: Variance inflation factor (VIF) and the tolerance that related to VIF. VIF of a variable measures the inflation of the variance of the variable's regression coefficient relative to a regression where all the other variables are independent (Landau and Everitt, 2004). Tolerance is related to VIF, which is its reciprocal (1/VIF). (Landau and Everitt, 2004). The basic rules are as follow: If the largest VIF is greater than 10, then there is a cause of concern (Bowerman and O`Connell, 1990). Moreover, if the tolerance is below 0.1, then there is a serious problem (Bowerman and O`Connell, 1990). And finally, if the tolerance is below 0.2, then there is a potential problem (Mernard, 1995).

Referring back to tables (18, 22, 26, and 30), the VIF and Tolerance values are summarized in table 32.

Table 32 : VIF and Tolerance Values

	Acquisition		***Conversion***		***Application***		***Protection***	
	Tol	VIF	Tol	VIF	Tol	VIF	Tol	VIF
Technology	.652	1.533	.656	1.525	.656	1.525	.653	1.533
Interaction	.306	3.271	.306	3.272	.306	3.272	.305	3.273
Innovative	.298	3.350	.311	3.215	.311	3.215	.309	3.239
Decentralization	.332	3.014	.344	2.904	.344	2.904	.342	2.920
Integration	.592	1.688	.597	1.675	.597	1.675	.593	1.687

Note: Tol: Tolerance, VIF: Variance Inflation Factor

It is noticed in table 32 that the greater VIF value of all the variables is less than 10 and the greater Tolerance Value is greater than 0.2. The VIF values of the variables that related to Knowledge Acquisition Process are: 1.533 for Technology, 3.271 for Interaction, 3.350 for Innovative Culture, and 3.014 for Decentralization, and 1.688 for Integration. The second measure is the tolerance for each of the independent variables. All of the tolerance values are not less than 0.2 (definitely not less than 0.1). Technology, Interaction, Innovative Culture, Decentralization, and Integration have a tolerance value of .652, .306, .298, .332, and .592 ordered respectively.

The VIF values of variables that related to Knowledge Conversion Process are: 1.525 for Technology, 3.272 for Interaction, 3.215 for Innovative Culture, 2.904 for Decentralization, and 1.675 for Integration. The tolerance values of the variables (Technology, Interaction, Innovative Culture, Decentralization, and Integration) are 0.656, 0.306, 0.311, 0.344, and 0.597 ordered respectively.

VIF values for each of the independent variable that related to Knowledge Application Process are: for 1.525 for Technology, 3.272 for Interaction, 3.215 for Innovative Culture, and 2.904 for Decentralization and 1.675 for Integration. The tolerance values for each of the independent variables (Technology, Interaction, Innovative Culture,

Decentralization, and Integration) are 0.656, 0.306, 0.311, 0.344, and 0.597 ordered respectively.

VIF values for each of the independent variable that related to Knowledge Protection Process are: 1.533 for Technology, 3.273 for Interaction, 3.239 for Innovative Culture, and 2.92 for Decentralization, and 1.67 for Integration. The tolerance values for each of the independent variables (Technology, Interaction, Innovative Culture, Decentralization, and Integration) are 0.653, 0.305, 0.309, 0.342, and 0.593 ordered respectively.

All VIF and tolerance values denote that there is no cause of concern of collinearity within the data. This strengthen our model by avoiding the problem of having interchangeable β values between independent variables and thus reduces bias and avoid type II error.

Regarding **normality and linearity** of data. The plots described in appendix show that the data have Bell shape. The other plots show the relationship between each dependent variable and independent variables, we notice that it have a linear shape that can be expressed in a linear relationship. VIF values, Tolerance values, Bell shapes, and linear relationships strengthen the model and validate the result for the purpose of generalizability.

Chapter Five: Findings, Discussions, and Recommendations

5.1 Introduction

This chapter presents the findings that emerged from data analysis and discusses them in the light of previous studies. It also highlights a number of recommendations.

5.2 The Relationship Between KM Infrastructure Capabilities and KM Process Capabilities

This study has proved that nearly all Knowledge Management Infrastructure Capabilities (Technology, Interaction, Innovative Culture, Decentralization, and Integration) influence the Knowledge Management Process Capabilities (Acquisition, Conversion, Application, and Protection), with the exception of Decentralization and Integration. Based on the multiple-regression analysis, the four main null hypotheses were rejected at a level of significance lower than 0.05. This finding is consistent to some extent with what has been proved in the previous studies.

More specifically, the **first main hypothesis** aimed at investigating the effect of Knowledge Management Infrastructure Capabilities on **Knowledge Acquisition Process** Capability. The results have shown that Knowledge Management Infrastructure Capabilities, which have the strongest effect on Knowledge Acquisition Process Capability, are as follows: Interaction (0.326), followed by Technological Infrastructure (0.302), and Innovative Culture (0.191) (see table 18).

The findings concerning the important effect of interaction have supported O'Dell and Grayson (1998), Grant (1996), and Gold et al. (2001), who have found that collaboration processes were critical capabilities for accumulating knowledge by interacting with parties inside and outside the organization. This highlights the value of Cultural Infrastructure aspects in facilitating processes oriented toward acquiring, sharing, and accumulating knowledge. Such cultural aspects include **Interaction** (Gold

et al., 2001; Anderson, 2009), collectivism (Wang et al., 2011), as well as having both a collaborative and cooperative culture (Saeed et al., 2010; Lee et al., 2007), which are considered to consist in what is known as the social network (Kim et al.,2010) of the organization. A number of studies have found social networks to be positively associated with Knowledge Management Processes. More specifically, Kim et al. (2010) reported that employees working in organizations with strong social network, experience higher levels of Knowledge Acquisition compared with employees working in organizations with weak social network.

Furthermore, Chen et al. (2007) supported the important role of socialization in effective knowledge management activities when they found that cooperative climate and social interaction were positively related to Knowledge Sharing. Saeed et al. (2010) and Lee et al. (2007) supported the result by investigating collaborative culture. They found that collaborative culture had a positive and significant influence on the knowledge creation process. The explanation for this is that collaborative culture facilitates knowledge exchange (Nahapiet & Ghoshal, 1998) by reducing fear and increasing openess among members (Lee and Choi, 2000) which enhances the Knowledge Creation Process.

Another cultural aspect is the **Innovative Culture**. The effect of innovative culture on Knowledge Management Acquisition was supported by Chen et al. (2010) findings in that innovative climate had a positive and significant influence on knowledge creation and knowledge sharing processes. This is explained by the argument that if firms possess a higher level of innovative climate, employees will be more inclined to exchange and share knowledge for creative thoughts (chen et al., 2007).

Regarding the effect of **Technological Infrastructure** Capability on Knowledge Acquisition Process Capability, many researchers have found that Information Technology (IT) is a crucial element for efficient Knowledge Management Processes (Gold et al., 2001; Davenport & Prusak, 1998; Lee and Lee 2007; Handzic, 2011; Kim et al. 2010; Anderson, 2009). Lee and Lee (2007) have explained this view in that IT facilitates rapid collection, storage, transferring, and exchange of knowledge on a scale not practicable in the past. In addition, Information Technology facilitates communication among employees, functions, and organizations; and knowledge sharing. Thus, IT has been shown to be a significant enabler of employees' Knowledge Acquisition (Kim, 2010) and Knowledge Creation Processes (Lee and Lee, 2007; Handzic, 2010).

This study did not find that **Decentralization and Integration** had an insignificant effect on Knowledge Management Process. There have been mixed results on the effect of structure on knowledge management processes or effectiveness. For example, Gold et al. (2001) found that the Structural Infrastructure has a positive effect on knowledge management effectiveness. Many studies have shown that the degree of centralization was negatively associated with employee knowledge Acquisition (Kim, 2011) or Creation process (Chen et al., 2010), and that the degree of integration had a positive and significant effect on knowledge Acquisition (Kim, 2011), Creation (Chen et al., 2010), and Sharing (Chen et al., 2007; Chen et al., 2010).

In contrast with the aforementioned results, Peachey (2006) found that the structure has insignificant effect on KM effectiveness as well as technological capabilities did not

moderate the relationship between structure and KM effectiveness. Peachey explained that based on Orlikowski (2000) argument that people are willing to bypass an organization's structure in order to do their job. Another perspective that explains the insignificance effect of Decentralization and Integration is that Technology in terms of communication networks can enable particular structure and can eliminate barriers between parts of the organization. It allows collaboration between structurally and geographically separated parts of the organization (Gold et al., 2001; Teece, 1998).

The **Second main hypothesis** aimed at investigating the effect of Knowledge Management Infrastructure Capabilities on **Knowledge Conversion Process** Capability. The results have shown that Knowledge Management Infrastructure Capabilities, which have the strongest effect on Knowledge Conversion Process Capability, are as follows: Interaction (0.545) followed by Technological Infrastructure (0.271) (see table 22).

This finding supports the previous studies on cultural influences on knowledge conversion process. More specifically, **Interaction**, many researchers have investigated this aspect as well as other related cultural aspects. They found that culture enables knowledge conversion or creation (Lee and Choi, 2000; Anderson, 2009; Wang et al., 2011; Saeed et al., 2010; Lee et al., 2007; Handzic, 2011; Chen et al., 2010).

Regarding Technological Infrastructure Capability, Lee and Choi (2000) did not find a significant relationship between **Information Technology** and creation processes, but they found a significant effect on combination process only. However, the advancement in Information Technology encourages scholars to investigate its effect on the business processes as well as knowledge management processes. Many researchers have found

that IT is a crucial element and enabler for efficient Knowledge Management Processes (Gold et al., 2001; Davenport & Prusak, 1998; Lee and Lee 2007; Handzic, 2011) in that IT facilitates exchange of knowledge, generating, facilitating, usage, transferring, and integrating fragmented flows of knowledge.

The findings have showed that Interaction and Technology enable organizations to classify, distribute, and integrate different sources and types of knowledge. Thus, organizations transform knowledge in the form of new products, enhanced products, improved efficiency, and right decisions.

Our study findings showed that **Innovative Culture** did not influence Knowledge Conversion, but Tseng (2009) found that culture enables knowledge conversion in which it produces a dynamic, entrepreneurial, and creative workplace; encourages individuals, provides freedom, and encourages employees to take risks. Peachey (2006) found no statistical significant relationship between Innovative Culture and KM effectiveness in terms of practices that were followed to facilitate knowledge acquisition, knowledge conversion, and use knowledge to achieve organization's objectives. The insignificance effect of Innovative Cultural on Knowledge Conversion Process might be explained in that Innovative Culture seems to be more important for acquiring new knowledge and creating new ideas than converting knowledge.

Knowledge Conversion practices such as classifying, distributing, integrating, and combining need an Information Technology and Interaction among employees to improve knowledge and transform it into form of new products or enhanced decisions (Tseng, 2009; Jaw and Liu, 2003; Sveiby & Simons, 2002).

The **Third main hypothesis** aimed at investigating the effect of Knowledge Management Infrastructure Capabilities on **Knowledge Application Process** Capability. The results have shown that Knowledge Management Infrastructure Capabilities, which have the highest degree effect on Knowledge Application Process Capability are as follows: Information Technology (0.374), followed by Interaction (0.249) and Innovative Culture (0.236) (see table 26).

Many studies have reported that Culture (Anderson, 2009; Handzic, 2011; Chen et al., 2007, Chen et al. 2010) and Technology (Kim et al., 2010; Anderson, 2009; Lee and Lee, 2007, Handzic; Kim 2010) had an effect on Knowledge Application Process.

Davenport and Prusak (1998) have noted several reasons for organizational members to access and assimilate knowledge but not apply it (i.e. act upon it): distrusting the source of knowledge, opportunity to apply knowledge, or risk aversion (particularly in organizations that punish mistakes). Thus, it is important for organizations to understand the **cultural factors** that affect employees' knowledge application capabilities for problem solving and decision-making.

Technological Infrastructure (Information Technology) had the strongest influence on Knowledge Application Process. Kim et al. (2010) found that Utilization of IT is the strongest predictor of employee's knowledge application. They have explained this based on Alavi and Leidner (2001) findings in that IT application utilization can support knowledge usage and application by embedding knowledge into organizational routines. Many organizations are enhancing the ease with which directives (repair manual,

policies, procedures, and standards) are accessed and maintained by making them available on organizational intranets.

As a result, Information Technology, Interaction, and Innovative Culture support the employee's ability to use knowledge for the purpose of problem solving, dealing with challenges in the organization, decision-making processes, and creating new products.

The **Fourth main hypothesis** aimed at investigating the effect of knowledge management infrastructural capabilities on **Knowledge Protection Capability**. The results have shown that Knowledge Management Infrastructure Capabilities, which have the strongest effect on Knowledge Protection Process Capability are as follows: Information Technology (0.412) followed by Innovative Culture (0.246). It has been noticed that a small number of empirical studies have discussed Knowledge Management Infrastructure Capabilities influence on Knowledge Protection Process (Gold et al., 2001; Anderson, 2009; Chang et al., 2007).

Information Technology was found as the most important enabler for the Knowledge Protection Process. This can be explained by the need for systems and techniques to specify who has the authority to access a specific knowledge, how to protect the knowledge from parties inside and outside the company where the database can be accessed by internet or intranet. Firewall and access codes have shown as popular techniques that protect database and monitor individuals who access.

The findings have showed that **Innovative Culture** is a predictor of Knowledge Protection Process. The assumption behind the positive effect of Innovative Culture on the Knowledge Protection Process is that when employees get encouraged to be

innovative, that reflects a positive culture that organization offers. Positive cultural aspects include: a warm and friendly workplace where people can freely share knowledge; a dynamic, entrepreneurial, and creative workplace which encourages individual initiative, provides freedom, and encourages individual to take risks (Tseng, 2010). In turn, creative environment affects negatively on intent to turnover (Mayfield et al., 2008).

Jacobs et al. (2007) found a significant and negative relationship between knowledge sharing behavior and turnover intentions. Therefore, in such a culture, employees are likely to stay more in the organization and keep their valuable knowledge inside the organization boards, and more likely to share knowledge on behalf of the organization. However, a research has been done by Chang and Lin (2007) found that there is no significant relationships between the innovativeness and confidentiality.

The findings have showed that **Interaction** had no significant influence on Knowledge Protection Process Capability. This result supports Anderson (2009) findings that have not found significant relationship between Culture in terms of interaction and Knowledge Protection. Comparing these findings with relevant literature, Chang et al. (2007) found that cooperativeness was negatively related to confidentiality. Although cooperativeness encourages organization to share information internally, but it is difficult to hold the principle of confidentiality in such an information sharing environment (Chang et al., 2007). Curry and Moore (2003) supported this finding in that the sharing of information was often hampered by a perceived need for confidentiality.

5.3 Conclusions

This study has proved that nearly all Knowledge Management Infrastructure Capabilities (Technology, Interaction, Innovative Culture, Decentralization, and Integration) influence the Knowledge Management Process Capabilities (Acquisition, Conversion, Application, and Protection), with the exception of Decentralization and Integration Capabilities.

The results showed that Knowledge Acquisition Process Capability was most affected by Interaction, followed by Technological Infrastructure, and Innovative Culture. Knowledge Conversion Process Capability was most affected by Interaction followed by Technological infrastructure. Knowledge Application Process Capability was most affected by Technological Infrastructure (IT), followed by Interaction and Innovative Culture. Knowledge Protection Process Capability was most affected by Technological Infrastructure (IT), followed by Innovative Culture.

The results showed that Interaction is a critical infrastructure capability that influences Knowledge Acquisition and Knowledge Conversion Processes. This shows the important role of the human factor and the environment where they work to create new knowledge. Based on the resource-based view of strategy and social capital theory, it is important to focus on the transfer, accumulation, and development of expertise and knowledge embedded in employees to achieve competitive advantages.

Technological Infrastructure in terms of (IT) is a crucial enabler that enables knowledge Application and Protection Processes. This shows the IT utilization advantages over people and their norms and values in applying knowledge application and protection processes.

5.4 Recommendations

In the light of the findings of the study, a set of practical recommendations has emerged. The findings of study have showed that pharmaceutical manufacturing companies apply knowledge management processes to a good extent. The following implications help companies that suffer from the lack of knowledge management practices or those are willing to improve their practices. In turn, it decreases the gap between the practice and theory.

Organization that is willing to improve its **Knowledge Acquisition Process** Capability, should follow the practices of organizations that own high performance; generate new knowledge from the existing knowledge; use feedback from their projects to improve their performance; meet and exchange the expertise with other organization; acquire knowledge about new products; acquire knowledge from stakeholders (partners, suppliers, competitors, customers, etc); and design processes to exchange knowledge among individuals.

These practices are facilitated by interaction, innovative culture, and Technology. Interaction occurs when employees participate in decision-making process, ask their colleagues for assistance, interact with other groups, and discuss their work with people in other workgroups inside and outside the organization. IT allows organization to scan its stakeholders (e.g. Customers, Competitors, Suppliers, etc), allows employees to collaborate with other people inside or outside the organization, allow it to gather and acquire new knowledge. Innovative Culture allows organizations' employees to find new methods to perform their tasks, and to suggest ideas for new opportunities.

Improving **Knowledge Conversion Process** Capability demands organization follow practices that gains classifying, distributing, and combining and integrating different sources and types of knowledge. Thus transforming acquired knowledge into a form of new products, enhanced products, improved efficiency, and right decisions.

Interaction allows employees to ask their colleagues for assistance among the departments to apply the conversion process and to integrate the different knowledge (e.g explicit and tacit knowledge) types. Technology helps employees retrieve the available knowledge, classify it, and distribute it for the employees.

Improving **Knowledge Application Process** Capabilities demands organization follows a set of practices designed to access, store, and retrieve knowledge easily; exploit knowledge to increase efficiency of work, modify products, develop strategies and behaviors, develop new products, and solve new problems. Team work where interaction occurs increase efficiency of work, and helps in developing the available knowledge. Innovative culture encourages employees to take risk in applying the knowledge. IT facilitates accessing for desired knowledge in a real time manner that enables managers and employees take right decisions and solve problems. In addition, it allows employees to use digital manuals, routines, products specification, and procedures to do their job.

Finally, organizations should **protect** their knowledge. They should design processes to protect knowledge from inappropriate use, which caused by its members as well as from outsiders. They should have processes to protect knowledge from theft from within the organization as well as from outside the organization, have incentives in place that encourage the protection of knowledge. They should have extensive policies and

procedures for protecting trade secrets and intellectual property rights; and linking IT with protection mechanisms. These activities are facilitated by technology in which it specifies who has the authority to access a specific knowledge as well as to protect the knowledge from parties inside and outside the company. In addition, innovative culture affects knowledge protection in that it encourages employee to stay in the organization. Thus, it keeps embedded knowledge and expertise in employees inside the organization boundaries.

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Appendices

Appindex I : Study Questionnaire



The University of Jordan
Faculty of Business Administartion

Knowledge Management Infrastructure Capabilities and Knowledge Management Process Capabilities

Dear Participant,

This Questionnaire is considered as a part of a study that is conducted to identify the most important factors that facilitate the successful implementation of knowledge management processes which are Knowledge Acquisition, Knowledge Conversion, Knowledge Application, and Knowledge Protection. These factors are collectively known as knowledge management infrastructure capabilities, which include Technology, Structure, and Culture.

All the responses will be confidential data and will be used for the research purposes only. In return for your cooperation, I will send you a written report of the main study finding.

Please do not hesitate to ask about any questions regarding the study through any of the following contacts.

Best Regards

Researcher Name: Aziz Arafa

Contact info:

Mobile: 0785906321

Email: Azizcom83@yahoo.com

Company Information
Please check the right box which accurately reflects your current situation:

Job Title	Executive Manager ○	Divisional Manager ○	Section Head ○	Other: --------------------------------		
Size of Company: (Personnel)	Less than 40 ○	40-70 ○	71-100 ○	101-130 ○		More Than 130 ○
Company Age (years)	Less Than 5 ○	5-9 ○	10-14 ○	15-19 ○	20-25 ○	More than 25 ○
Educational Level	High School ○	Diploma ○	Bachelor ○	Master ○		Doctoral ○
Experience level (years)	Less Than 5 ○	5-9 ○	10-14 ○	15-19 ○		More Than 20 ○

	Knowledge Acquisition Process Please check the right box which accurately reflects your current situation:	Not At All	Rarely	Sometimes	Mostly	Always
1	My organizations pursue to follow the practices of high performance organizations					
2	My organization follows a set of activities designed to generate new knowledge from the existing knowledge that its individuals posses					
3	My organization uses feedback to improve its performance					
4	My organization meets and exchanges the expertise with other organizations in the same industry					
5	My organization Is keen on acquiring knowledge about new products within our industry					
6	My organization follows a set of activities designed to acquire knowledge from stakeholders (partners, suppliers, competitors, customers, ….)					
7	My organization follows a set of activities designed for exchanging knowledge between individuals					

	Knowledge Conversion Process Please check the right box which accurately reflects your current situation:	Not At All	Rarely	Sometimes	Mostly	Always
8	My organization follows/uses a set of activities designed for classifying knowledge					
9	My organization follows a set of activities designed for distributing knowledge throughout the organization.					
10	My organization follows a set of activities designed for integrating different sources and types of knowledge.					
11	My organization follows/uses a set of activities designed for transforming acquired knowledge into new products					

12	My organization follows/uses a set of activities designed for transforming acquired knowledge into decisions and plans					

	Knowledge Application Process Please check the right box which accurately reflects your current situation:	Not At All	Rarely	Sometimes	Mostly	Always
13	My organization modifies its products, strategies, and behaviors in the light of its past experience					
14	My organization uses a set of activities designed for using the available knowledge in development of new products					
15	My organization uses a set of activities designed for using the available knowledge to solve new problems					
16	My organization uses the available knowledge to improve its productivity					
17	My organization stores and retrieves the available knowledge					

	Knowledge Protection Process Please check the right box which accurately reflects your current situation:	Not At All	Rarely	Sometimes	Most ly	Always
18	My organization uses a set of activities designed to protect its knowledge from inappropriate use by its members					
19	My organization uses a set of activities designed to protect knowledge from inappropriate use outside parties					
20	My organization uses a set of activities designed to protect knowledge from theft from within the organization					
21	My organization uses a set of activities designed to protect knowledge from theft from outside the organization					
22	My organization has incentives in place that encourage the protection of knowledge					
23	My organization has extensive polices and procedures for protecting trade secrets and intellectual property rights					

	Cultural Infrastructure Capability Please check the right box which accurately reflects your current situation:	Not At All	Rarely	Sometimes	Mostly	Always
24	In my organization high levels of employees participation in decision making are encouraged and expected					
25	In my organization employees are encouraged to ask others for assistance when needed					
26	In my organization employees are encouraged to interact with other groups					
27	In my organization employees are encouraged to discuss their work with people in other workgroups					
28	My organization shares its knowledge with other organizations (e.g. partners, trade groups)					
29	I am encouraged to find new methods to perform a task					

30	I am encouraged to take risks even if that turns out to be a failure					
31	I am encouraged to suggest ideas for new opportunities					

	Structural Infrastructure Capability Please check the right box which accurately reflects your current situation:	Not At All	Rarely	Sometimes	Most ly	Always
32	Organization gives employees autonomy in decision making					
33	Organization's employees participate in decision making Process					
34	Organization's employee search for problem solutions from all possible sources					
35	Organizational departments at all levels communicate among each other without restrictions					
36	Organizational departments at all levels collaborate and share resources with each other without restrictions					
37	There are barriers that impede interaction among organizational members and departments					

	Technological Infrastructure Capability Please check the right box which accurately reflects your current situation:	Not At All	Rarely	Sometimes	Mostly	Always
38	My organization uses IT-enables Information Systems that allow it to scan its stakeholders (e.g. Customers, Competitors, Suppliers …)					
39	My organization uses IT-enables Information Systems that allow employees to collaborate with other people inside the organization					
40	My organization uses IT-enables Information Systems that allow employees to collaborate with other people outside the organization					
41	My organization uses IT-enables Information Systems that allow it to gather and acquire new knowledge					
42	My organization uses IT-enables Information Systems that allow it to retrieve and use knowledge					



الجامعة الأردنية
كلية إدارة الأعمال

قدرات بنية إدارة المعرفة التحتية وقدرات عملية إدارة المعرفة
Knowledge Management Infrastructure Capabilities and Knowledge Management Process Capabilities

عزيزي المشارك بالدراسة / عزيزتي المشاركة بالدراسة،
تحيه طيبة وبعد،
يعتبر هذه الاستبيان جزء من دراسة يسلكها الباحث لتحديد أهم العوامل التي تسهل التطبيق الناجح لعمليات إدارة المعرفة والتي تشمل، اكتساب المعرفة، تحويل المعرفة، تطبيق المعرفة، وحماية المعرفة. تُعْرف هذه العوامل بإجماع على أنها قدرات بنية إدارة المعرفة التحتية والتي تشمل التكنولوجيا ، الهيكل، والثقافة.
تعتبر البيانات المجموعة سريه وسوف تستخدم لأغراض البحث العلمي فقط. في مقابل هذا التعاون، سوف أرسل تقرير بأهم نتائج الدراسة.
أرجو عدم التردد في السؤال عن الدراسة عبر وسائل الاتصال المدونة بالأسفل.

ولكم جزيل الشكر.

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تلفون: 06-5355000-24244

- **معلومات حول الشركة:**

أرجو تعبئة الجدول التالي الذي يعكس المعلومات الديموغرافيه للشركه وذلك بوضع علامة داخل الدائرة أو ملء الفراغ

حجم الشركة (عدد الموظفين)	اقل من 40 ○	40- أقل من 70 ○	70- أقل من 100 ○	100- أقل من 130 ○		130 فأكثر ○
عمر الشركة (عدد السنوات)	اقل من 5 ○	5 - اقل من 10 ○	10 - اقل من 15 ○	15 - اقل من 20 ○	20 - اقل من 25 ○	25 فأكثر ○

- **معلومات معبئ الاستمارة:**

أرجو تعبئة الجدول التالي الذي يعكس معلومات حول معبئ الاستماره وذلك بوضع علامة داخل الدائرة أو ملء الفراغ

المسمى الوظيفي	مدير تنفيذي ○	مدير فرع ○	مدير دائرة ○	غير ذلك:..................................	
المستوى التعليمي	الشهادة الثانوية ○	الدبلوم ○	البكالوريوس ○	الماجستير ○	الدكتوراه ○
عدد سنوات الخبرة	اقل من 5 ○	5 - اقل من 10 ○	10 - اقل من 15 ○	15 - اقل من 20 ○	20 فأكثر ○

	- **عملية اكتساب المعرفة** أرجو تعبئة الجدول التالي الذي يعكس بدقه مدى تطبيق الشركة لعملية اكتساب المعرفة:	أبداً	نادرا	أحيانا	معظم الأوقات	دائما
1	تسعى الشركة إلى إتباع أساليب المنظمات ذات الأداء العالي في أداء عملياتها					
2	تقوم الشركة بمجموعه من الإجراءات لغرض توليد معرفه جديدة من المعرفة الموجودة لدى الموظفين					
3	تستخدم الشركة التغذية الراجعة من عملياتها ومشاريعها لتحسين أدائها					
4	تقوم الشركة باجتماعات دوريه وتبادل خبرات مع المنظمات التي تعمل في نفس نطاق الصناعة					
5	الشركة متحمسة لاكتساب المعرفة حول منتجات جديدة ضمن نطاق الصناعة					
6	تقوم الشركة مجموعه من النشاطات تهدف إلى اكتساب المعرفة من أصحاب المصالح (المزودون، المنافسون، الموزعون، الشركاء،الزبائن،........)					
7	تقوم الشركة بمجموعه من النشاطات تهدف إلى تبادل المعرفة بين الأفراد					

	- **عملية تحويل المعرفة** أرجو تعبئة الجدول التالي الذي يعكس بدقه مدى تطبيق الشركة لعملية تحويل المعرفة:	أبداً	نادرا	أحيانا	معظم الأوقات	دائما
16	تقوم الشركة بمجموعه من العمليات لتوزيع المعرفة في جميع أرجاء الشركة					
17	تقوم الشركة بمجموعه من الأنشطة التي تهدف إلى الدمج بين مصادر وأنواع المعرفة					
18	تقوم الشركة بمجموعه من الإجراءات تهدف إلى تصنيف أنواع المعرفة المتوفرة لديها					
19	تقوم الشركة بعمليات تحويل المعرفة المكتسبة إلى منتجات جديدة					
20	تقوم الشركة بعمليات تحويل المعرفة المكتسبة إلى خطط تنفيذيه					

	▪ **عملية تطبيق المعرفة** أرجو تعبئة الجدول التالي الذي يعكس بدقه مدى تطبيق الشركة الحالي لعملية تطبيق المعرفة:	أبداً	نادرا	أحيانا	معظم الأوقات	دائما
26	تعتمد الشركة بتعديل منتجاتها، واستراتيجياتها وتصرفاتها على تجاربها السابقة					
27	تقوم الشركة بمجموعه من الأنشطة التي تهدف لاستخدام المعرفة المتوفرة في تطوير منتجات جديدة					
28	تقوم الشركة بمجموعه من النشاطات التي تهدف لاستخدام المعرفة المتوفرة في حل المشكلات واتخاذ القرارات					
29	تستخدم الشركة المعرفة المتوفرة في تحسين الإنتاجية					
30	تقوم الشركة بوضع آليات تخزين واسترجاع للمعرفة					

	▪ **عملية حماية المعرفة** أرجو تعبئة الجدول التالي الذي يعكس بدقه مدى تطبيق الشركة الحالي لعملية حماية المعرفة:	أبداً	نادرا	أحيانا	معظم الأوقات	دائما
34	تستخدم الشركة مجموعه من الإجراءات تهدف إلى حماية المعرفة من الاستخدام الخاطئ من قبل موظفيها					
35	تستخدم الشركة مجموعه من العمليات تهدف إلى حماية المعرفة من الاستخدام الخاطئ من قبل أطراف خارجية					
36	تستخدم الشركة مجموعه من العمليات تهدف إلى حماية المعرفة من السرقة من قبل موظفيها					
37	تستخدم الشركة مجموعه من الإجراءات تهدف إلى حماية المعرفة من السرقة من قبل إطراف خارج الشركة					
38	هنالك حوافز تشجع حماية المعرفة					
39	تمتلك الشركة سياسات وإجراءات مكثفه لحماية أسرار الصناعة وحقوق ألملكيه الفكرية					

	▪ **قدرة البنية الثقافية التحتية** أرجو تعبئة الجدول التالي الذي يعكس بدقه قدرة البنيه الثقافيه التحتيه وذلك بوضع علامة داخل الصندوق المناسب:	أبداً	نادرا	أحيانا	معظم الأوقات	دائما
40	تشجع الشركة وتتوقع مستويات عاليه من مشاركة الموظفين في صناعة القرار					
41	تشجع الشركة الموظفين لطلب المساعدة من الآخرين عند الحاجة					
42	تشجع الشركة الموظفين على التفاعل مع المجموعات الأخرى (فرق العمل، المجتمع، .....)					
43	تشجع الشركة الموظفين على مناقشة أعمالهم مع أشخاص في مجموعات أخرى					
44	تشارك الشركة المعلومات مع منظمات أخرى (مثل الشركاء، مجموعة الصناعة،....)					
45	تشجعني الشركة لإيجاد أساليب جديدة لتنفيذ المهام الموكلة إلي					
46	تشجعني الشركة على تقبل المخاطرة في قراراتي حتى لو أدت المحاولة للفشل					
47	تشجعني الشركة على اقتراح أفكار لفرص جديدة					

	▪ **قدرة البنية الهيكل التحتية** أرجو تعبئة الجدول التالي الذي يعكس بدقه قدرة بنية الهيك التحتيه وذلك بوضع علامة داخل الصندوق المناسب:	أبداً	نادرا	أحيانا	معظم الأوقات	دائما
51	تعطي الشركة الموظفين استقلاليه في عملية صناعة القرار					
52	يشارك موظفو الشركة في عملية اتخاذ القرار					
53	يبحث موظفو الشركة بشتى الوسائل والمصادر عن حلول لمشاكل العمل					
54	دوائر الشركة بجميع مستوياتها تتصل يبعضها من دون قيود					
55	دوائر الشركة بجميع مستوياتها تتعاون وتتشارك المصادر بين بعضها من دون قيود					

56	هنالك عوائق تمنع التعاون بين موظفي الشركة وبين الأقسام المختلفة					

	▪ **قدرة بنية التكنولوجيا التحتية** أرجو تعبئة الجدول التالي الذي يعكس بدقه قدرة بنية التكنولوجيا التحتيه وذلك بوضع علامة داخل الصندوق المناسب:	أبداً	نادرا	أحيانا	معظم الأوقات	دائما
57	تستخدم الشركة أنظمة معلومات محوسبة تسمح بجمع معلومات حول أصحاب المصالح (الزبائن، المنافسون، المزودون،....)					
58	تستخدم الشركة أنظمة معلومات محوسبة تسمح للموظفين التعاون مع الموظفين داخل الشركة					
59	تستخدم الشركة أنظمة معلومات محوسبة تسمح للموظفين التعاون مع أشخاص خارج الشركة					
60	تستخدم الشركة أنظمة معلومات محوسبة تسمح للمنظمة جمع واكتساب معرفه جديدة					
61	تستخدم الشركة أنظمة معلومات محوسبة تسمح للمنظمة استرجاع واستخدام المعرفة					

Appendix II. Multiple regression plots

The first stage of multiple regression analysis is checking the assumptions of the model. This stage aims at determining the assumption of linearity and normality in the data (Field, 2004). Looking at figures depicted below, it was noticed that the normality of the residuals is achieved as the histogram takes the normal distribution shape (a bell shape curve). Figures show how the assumption of linearity is maintained. The data is evenly dispersed and do not take the shape of the funnel.

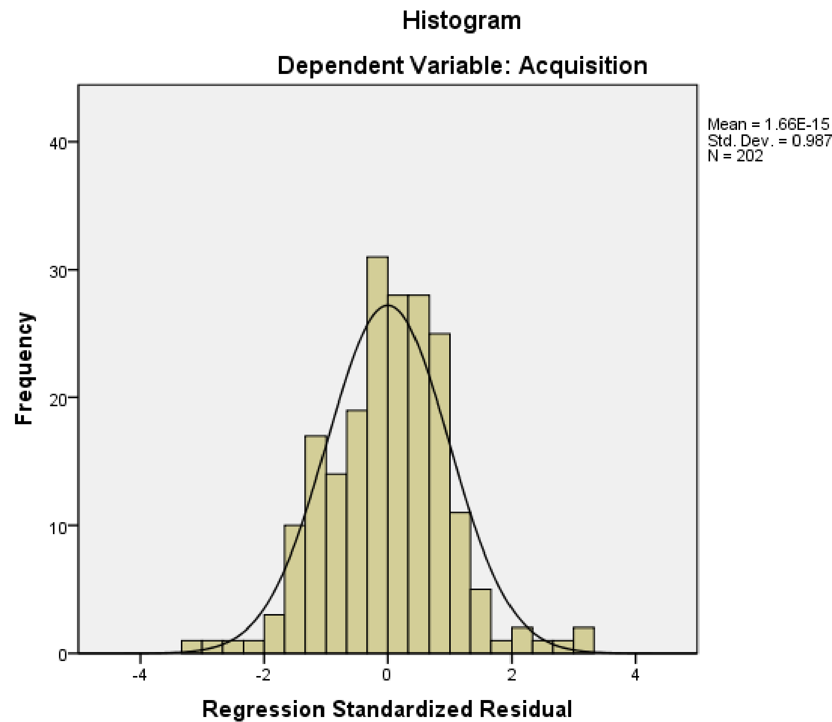


Figure 2: Knowledge Acquisition Process Capability Histrogram

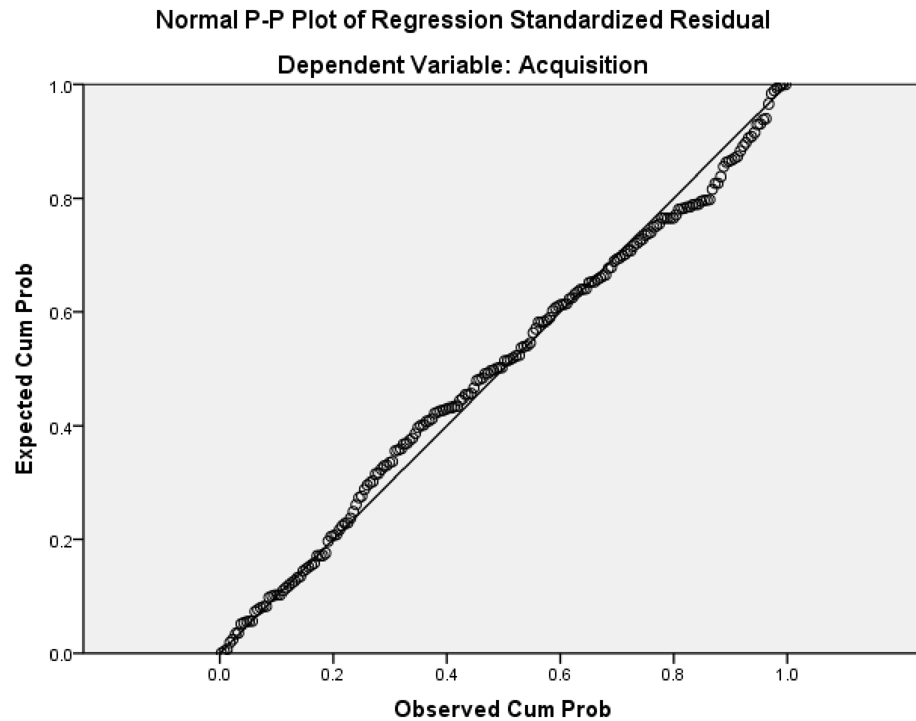


Figure 3: Normal P-P Knowledge Acquisition Capability process plot regression standard residuals

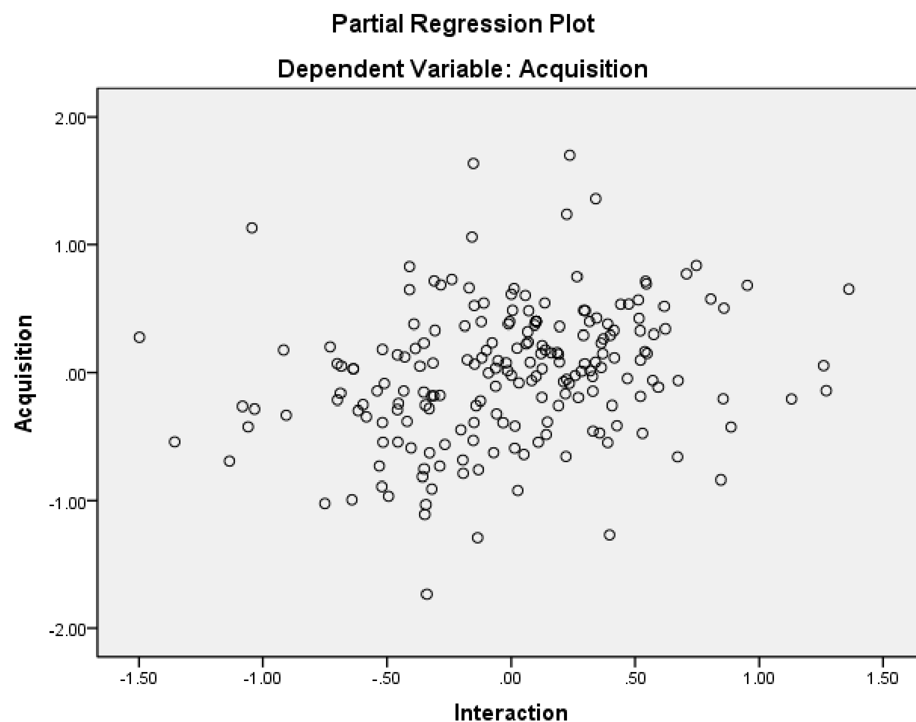


Figure 4: Knowledge Acquisition Process and Interaction plot

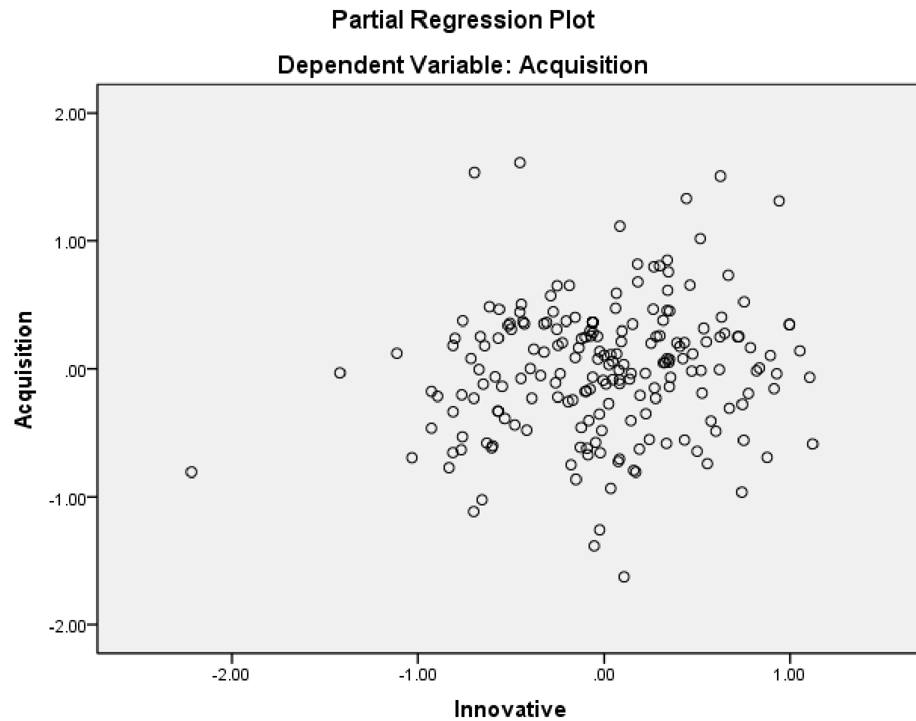


Figure 5: Knowledge Acquisition Process and Innovative Culture plot

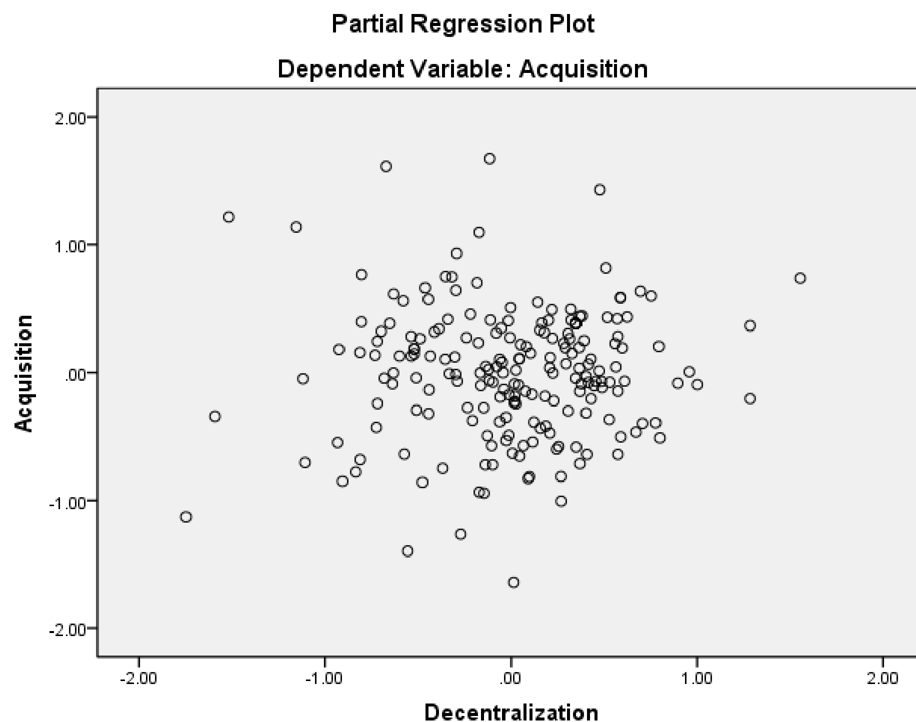


Figure 6: Knowledge Acquisition Process and Decentralization plot

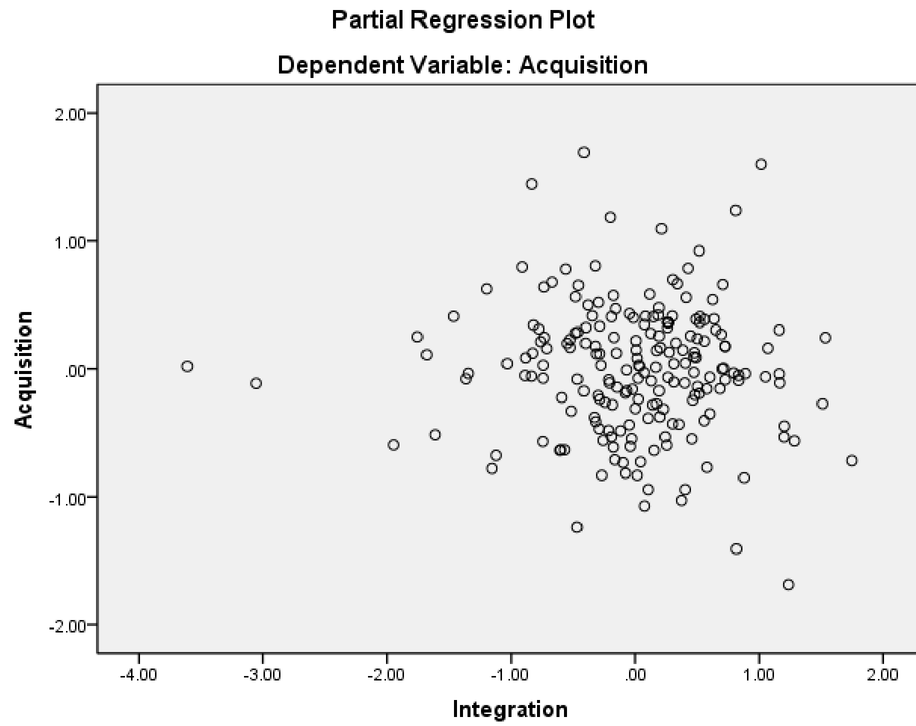


Figure 7: Knowledge Acquisition Process and Integration plot

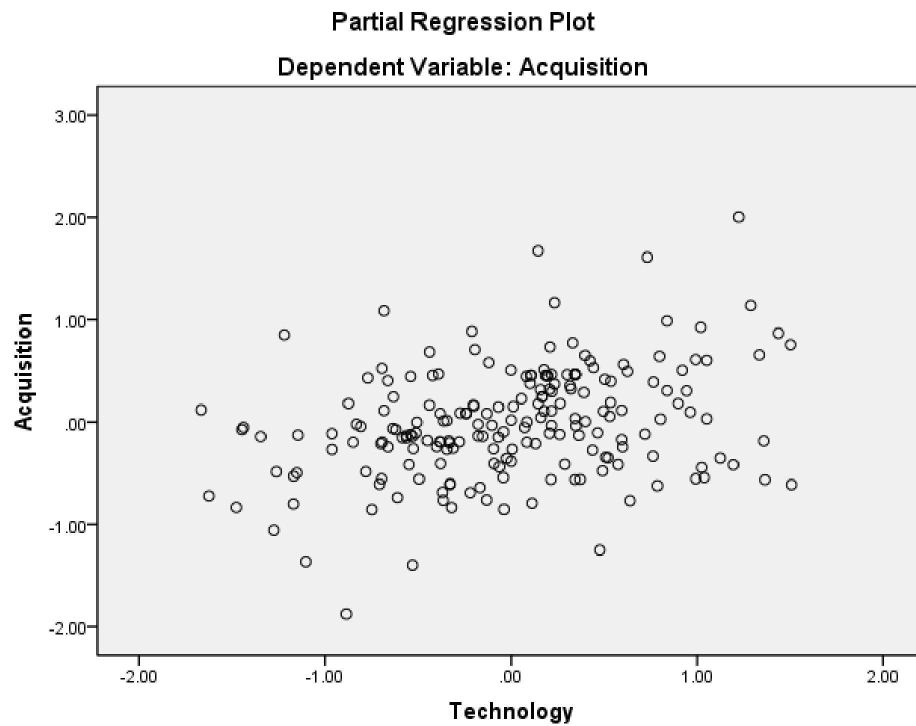


Figure 8: Knowledge Acquisition Process and Technology plot

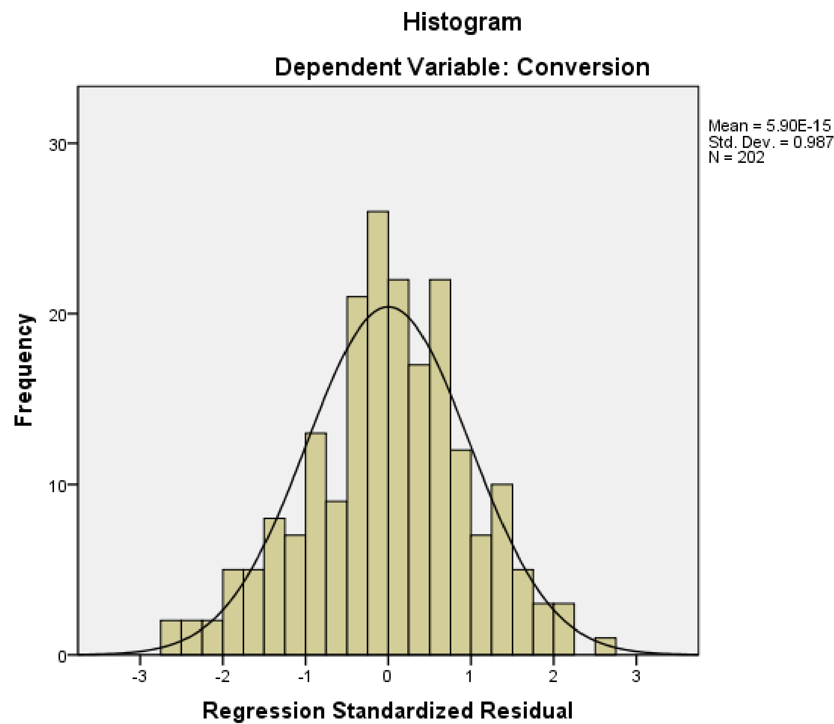


Figure 9: Knowledge Conversion Process Capability Histrogram

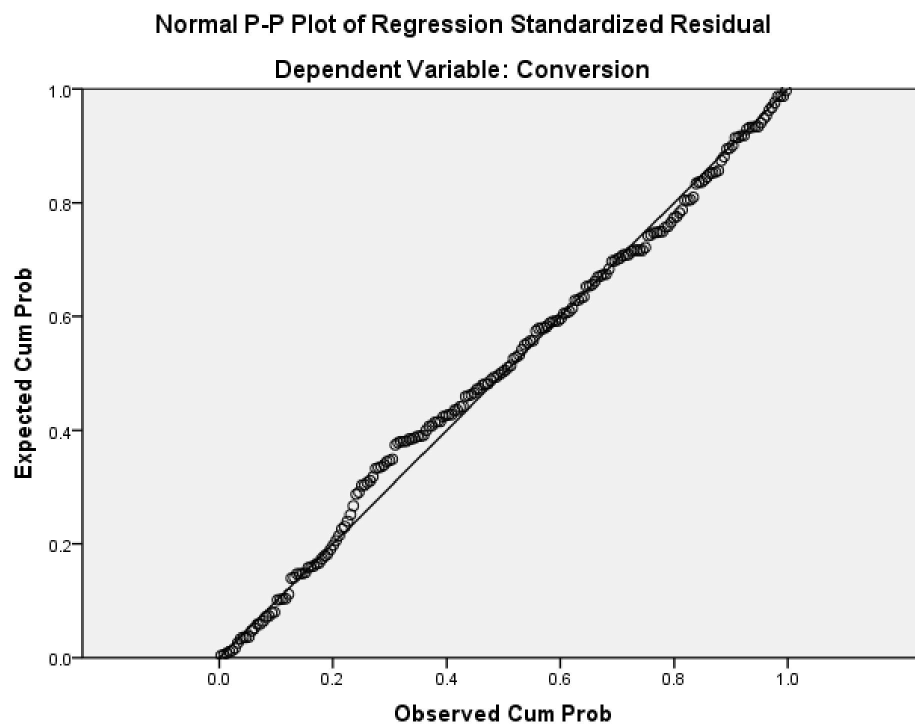


Figure 10: Normal P-P Knowledge Conversion Capability process plot regression standard residuals

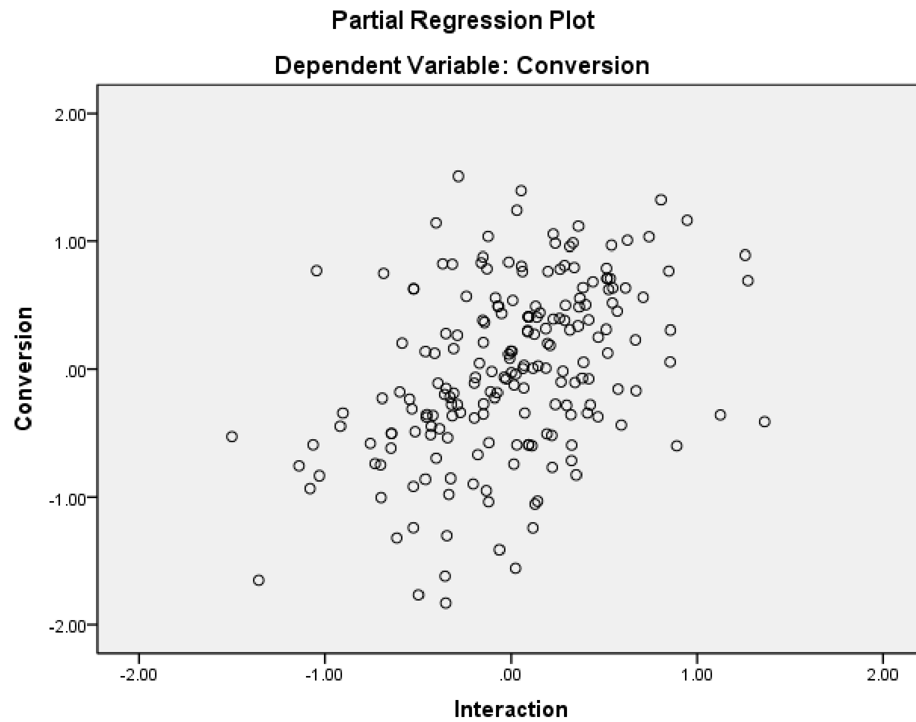


Figure 11: Knowledge Conversion Process and Interaction plot

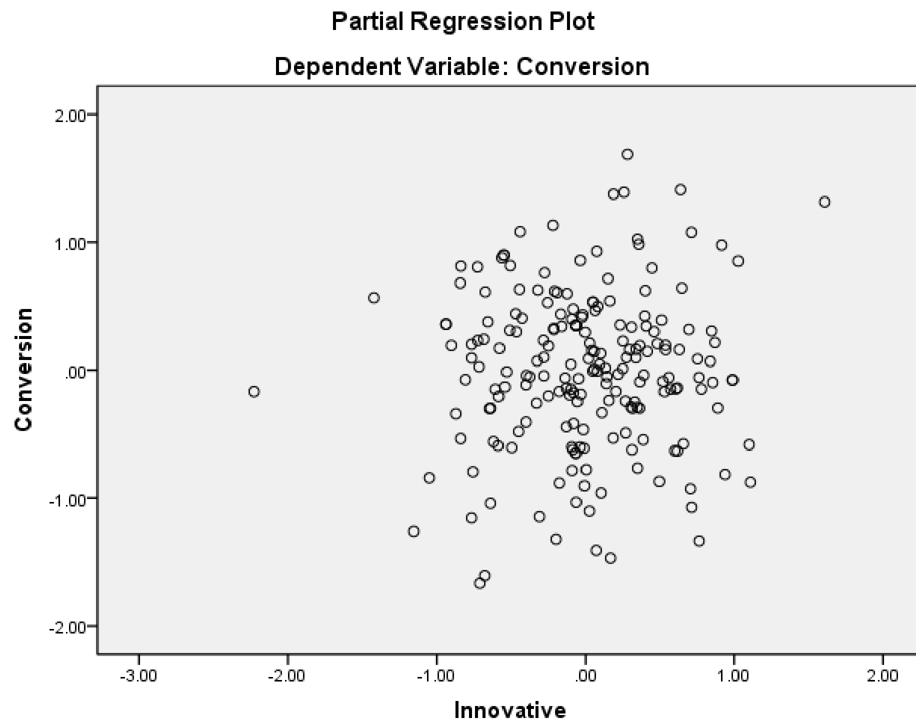


Figure 12: Knowledge Conversion Process and Innovative Culture plot

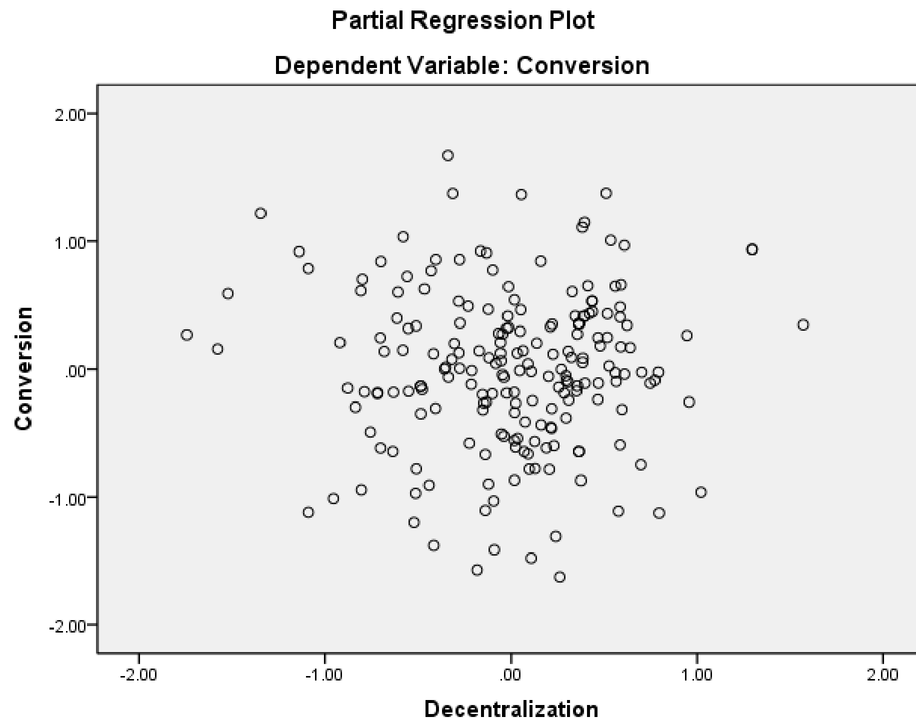


Figure 13: Knowledge Conversion Process and Decentralization plot

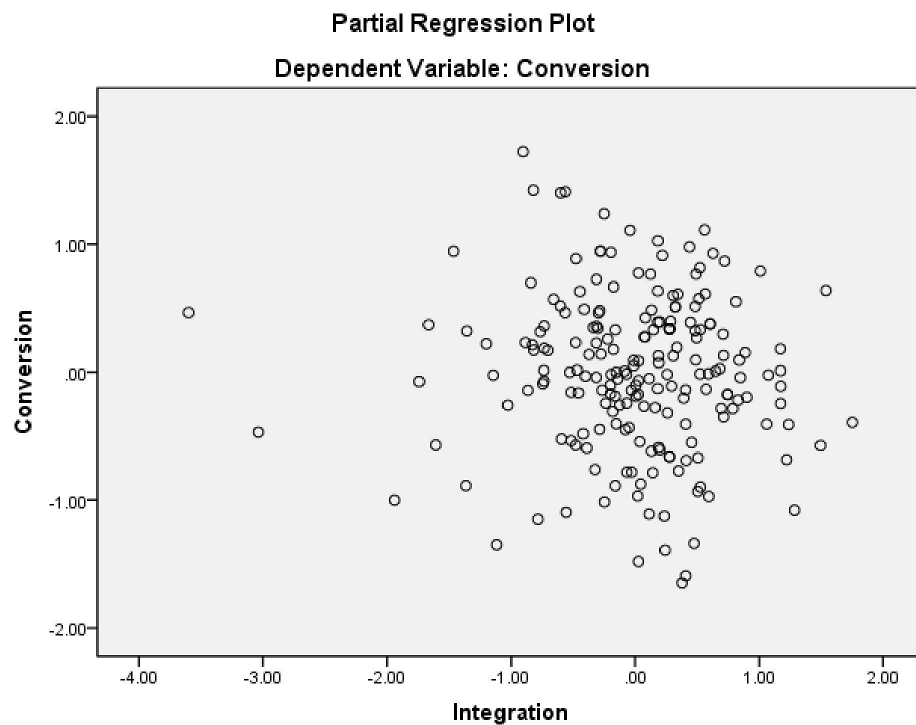


Figure 14: Knowledge Conversion Process and Integration plot

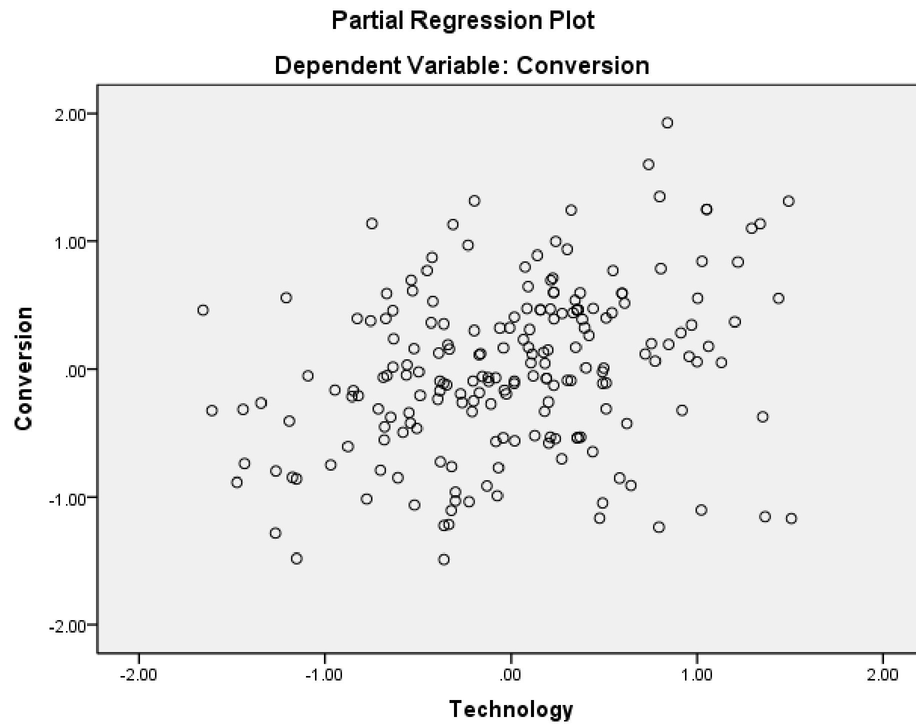


Figure 15: Knowledge Conversion Process and Technology plot

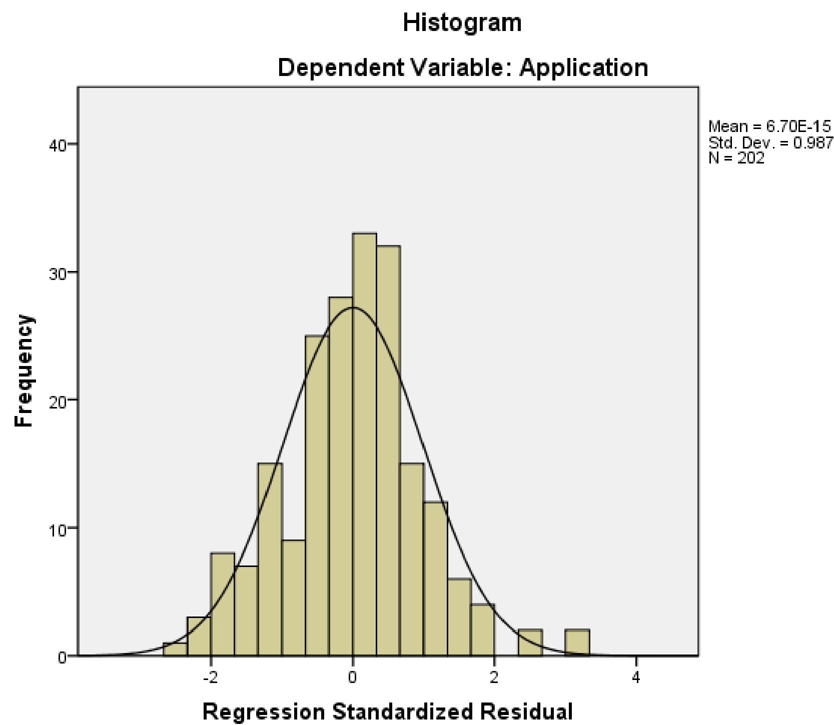


Figure 16: Knowledge Application Process Capability Histrogram

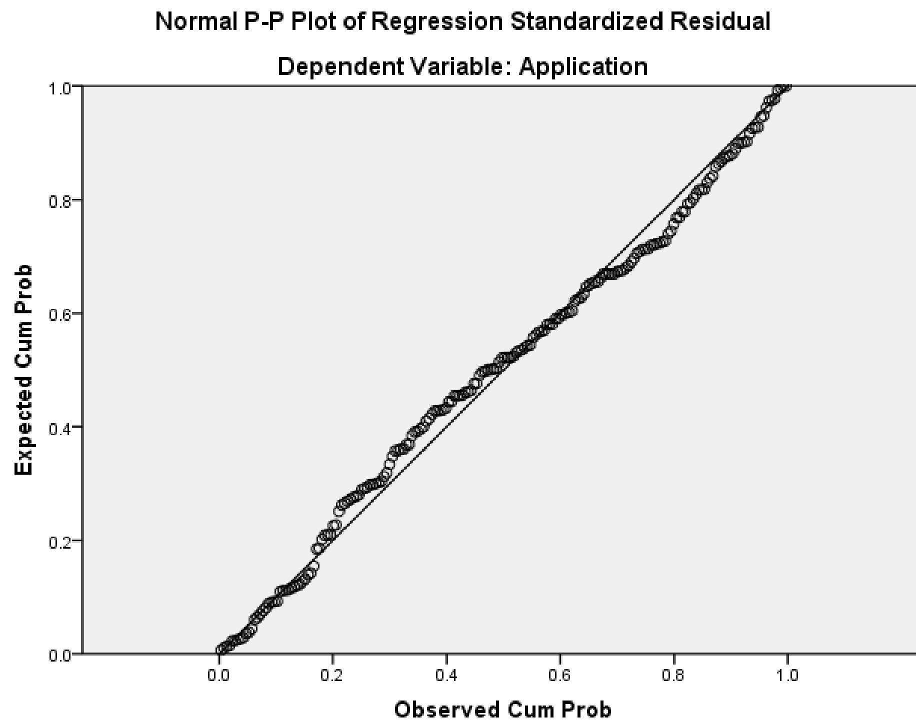


Figure 17: Normal P-P Knowledge Application Capability process plot regression standard residuals

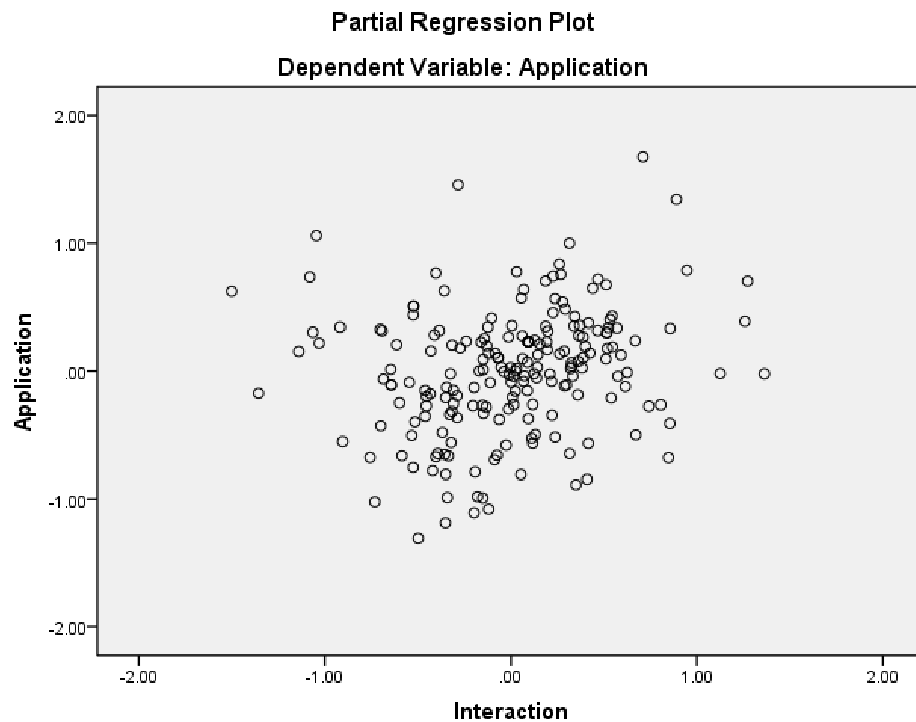


Figure 18: Knowledge Application Process and Interaction plot

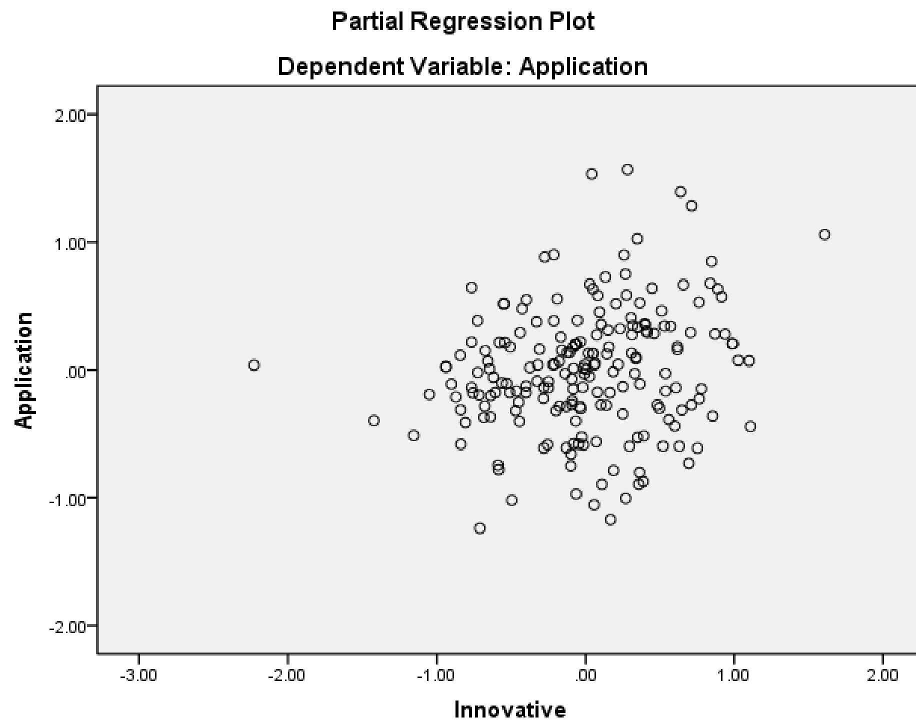


Figure 19: Knowledge Application Process and Innovative Culture plot

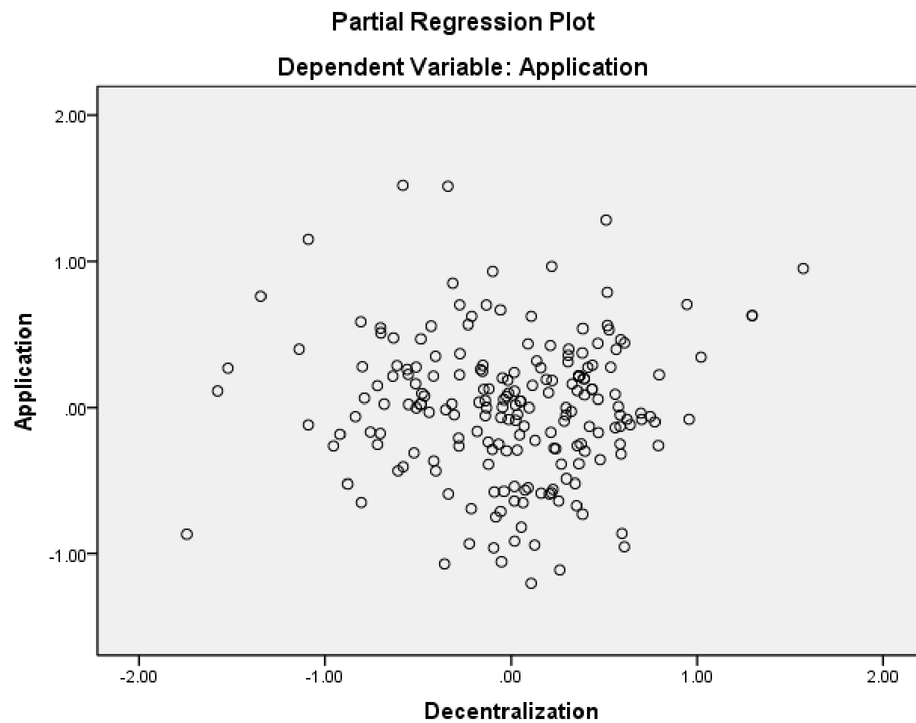


Figure 20: Knowledge Application Process and Decentralization plot

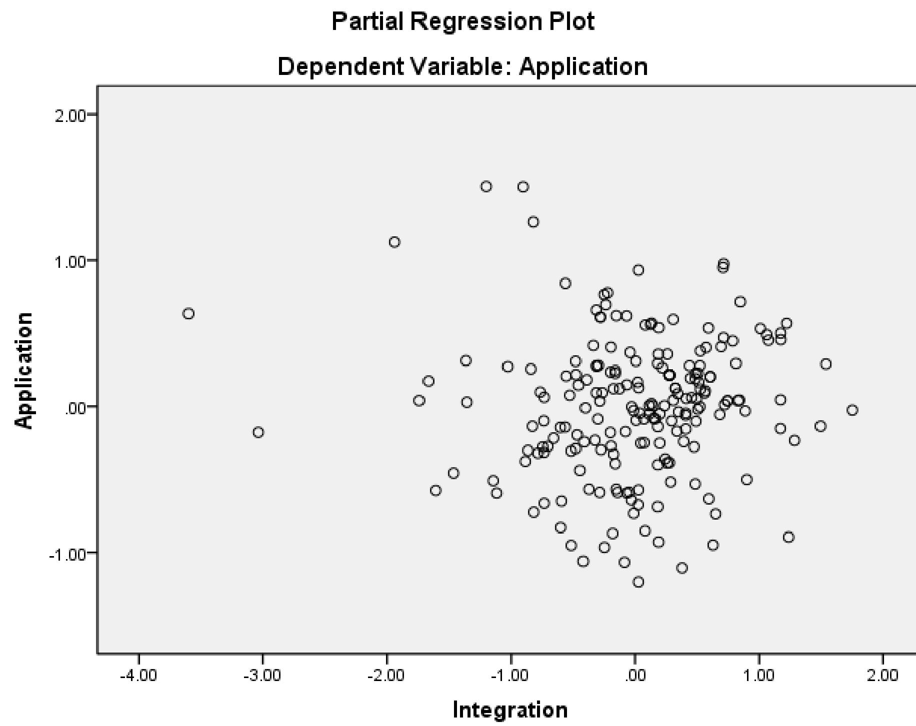


Figure 21: Knowledge Application Process and Integration plot

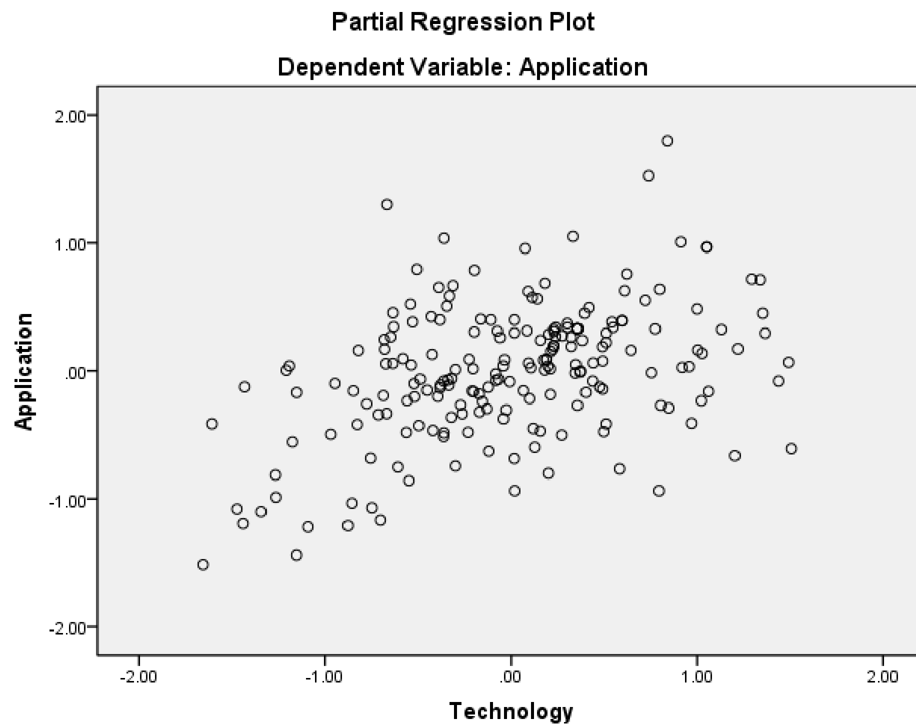


Figure 22: Knowledge Application Process and Technology plot

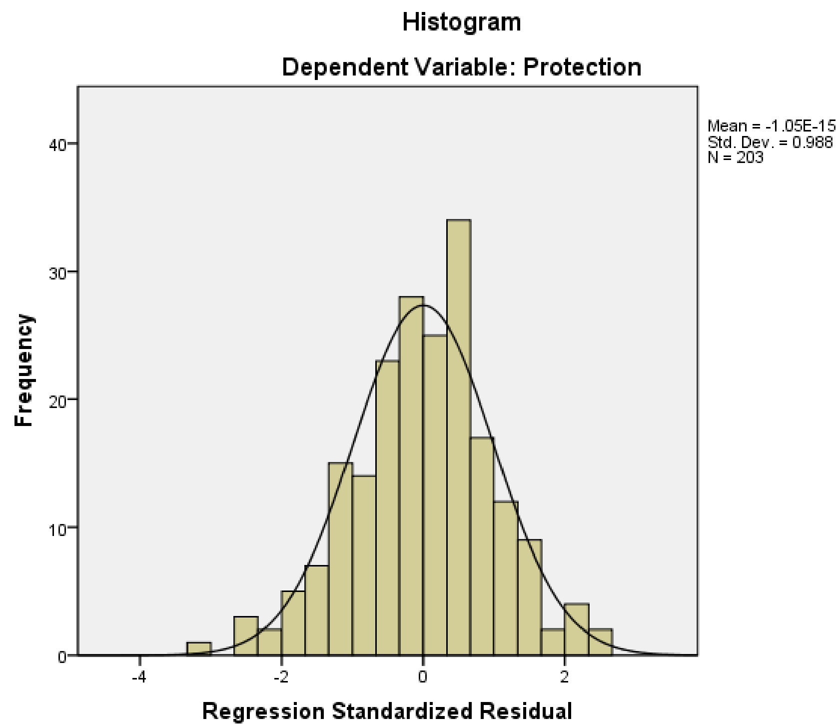


Figure 23: Knowledge Protection Process Capability Histrogram

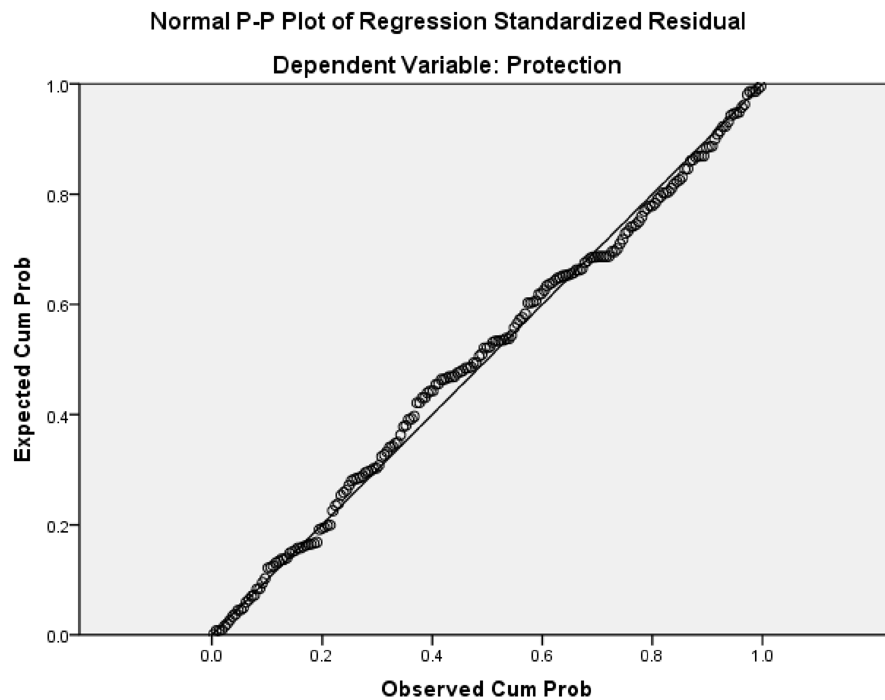


Figure 24: Normal P-P Knowledge Protection Capability process plot regression standard residuals

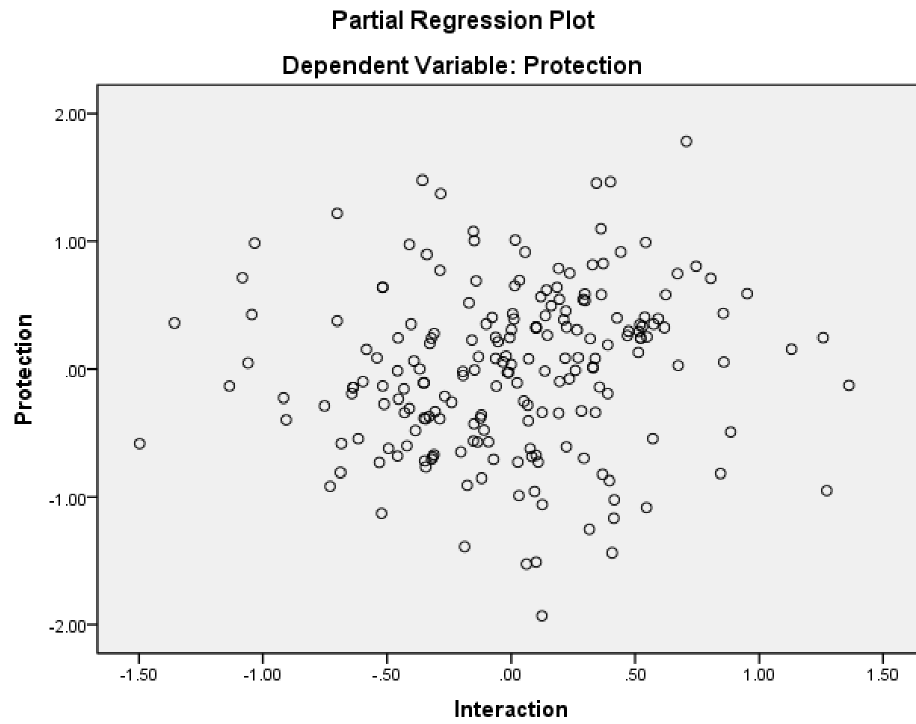


Figure 25: Knowledge Protection Process and Interaction plot

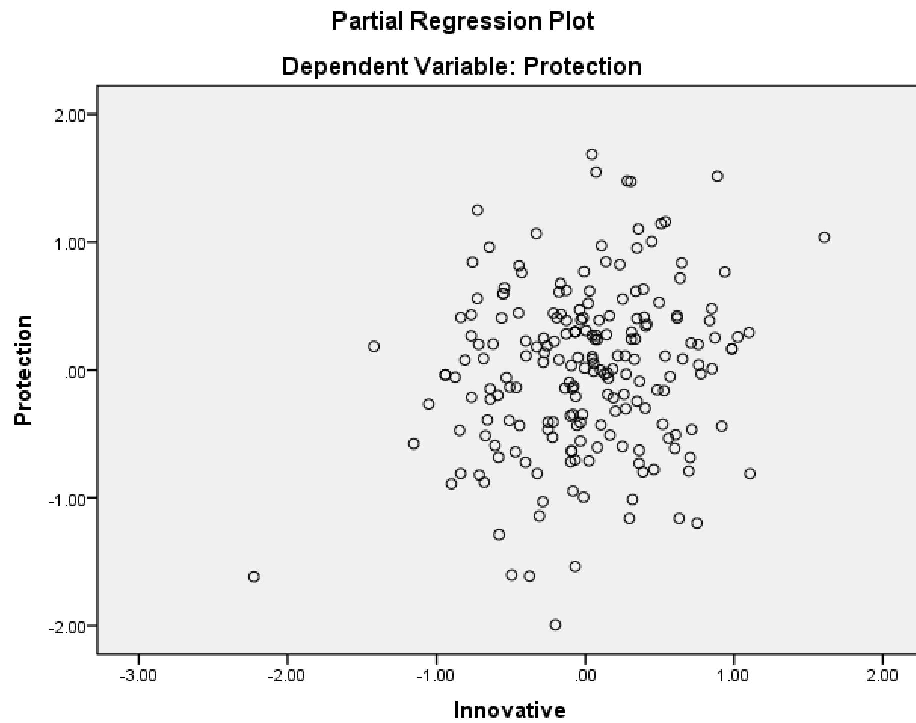


Figure 26: Knowledge Protection Process and Innovative Culture plot

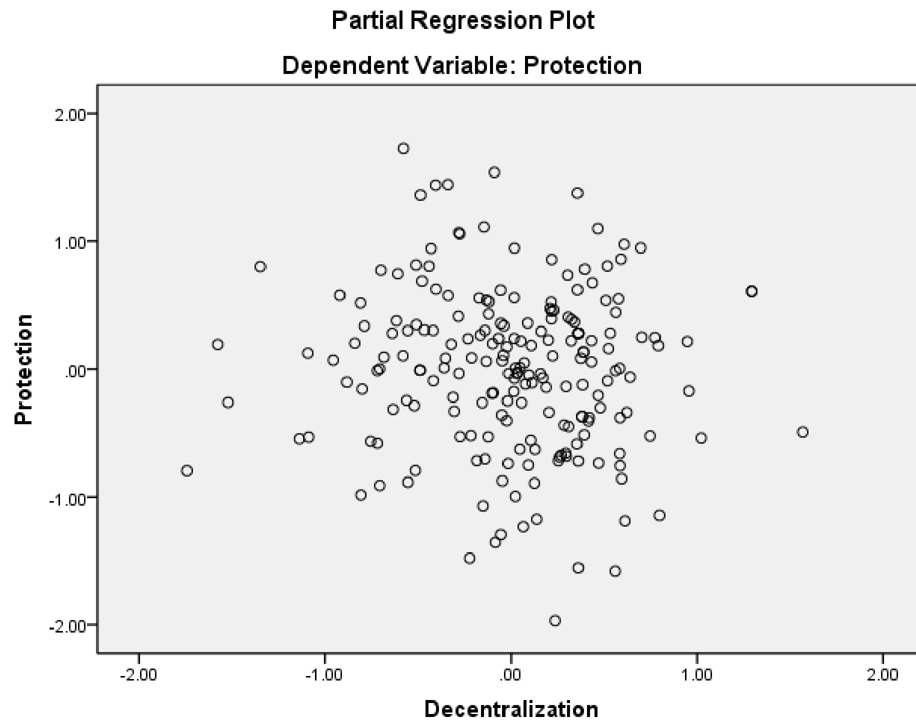


Figure 27: Knowledge Protection Process and Decentralization plot

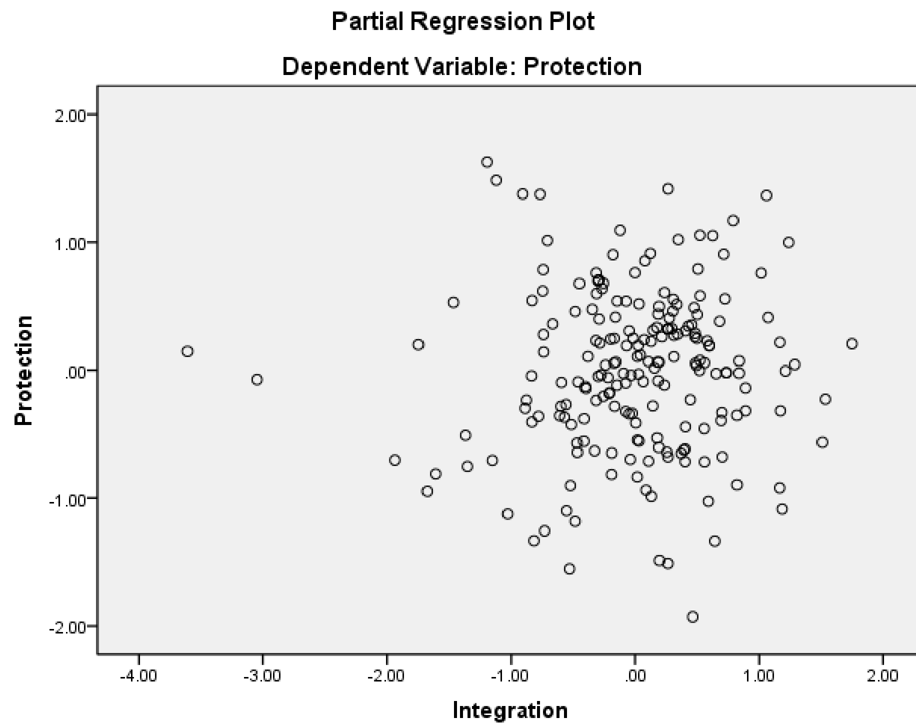


Figure 28: Knowledge Protection Process and Integration plot

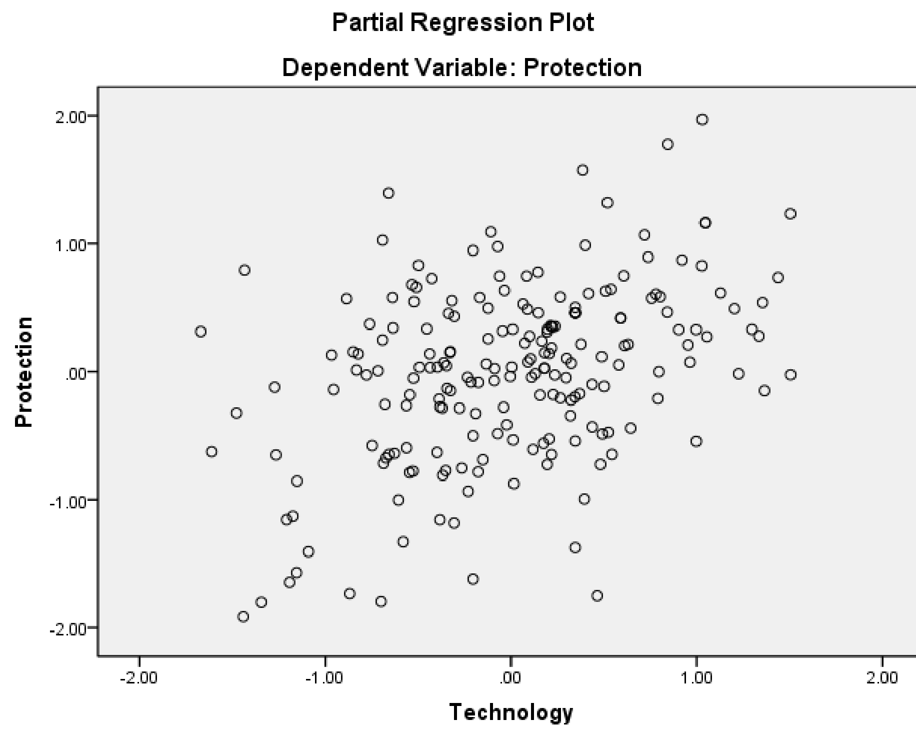


Figure 29: Knowledge Protection Process and Technology plot

أثر قدرات بنية إدارة المعرفة التحتية على قدرات عملية إدارة المعرفة في شركات إنتاج الأدوية في الأردن

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المشرف
الدكتور سامر عيد دحيات

الملخص

تهدف الدراسة إلى دراسة قدرات بنية إدارة المعرفة التحتية (التفاعل، الثقافة الإبداعية، اللامركزية، التكامل، والتكنولوجيا) على قدرات عملية إدارة المعرفة (اكتساب المعرفة، تحويل المعرفة، تطبيق المعرفة، وحماية المعرفة) . استخدمت الدراسة الاستمارة كأداة قياس لمتغيرات الدراسة. استهدفت الدراسة قطاع إنتاج الأدوية العامل في الأردن. واحد وعشرون شركه قبلت الالتحاق بالدراسة، كانت نسبة الاستجابة ثمانون بالمائة بواقع مائتان وثلاث استمارات من اصل مائتان وخمس وأربعون. تم استخدام تحليل الانحدار الخطي المتعدد لاختبار تأثير قدرات بنية إدارة المعرفة التحتية على كل قدرات عملية إدارة المعرفة . أهم نتائج الدراسة تعرض أن التفاعل هو بنيه تحتية حرجه تأثر على عمليتي اكتساب وتحويل المعرفة، أما التكنولوجيا فتعتبر بنيه تحتية حاسمه لعمليتي تطبيق وحماية المعرفة. على عكس النتائج السابقة، فان التكامل واللامركزية لم تكن مؤثره إحصائيا على أي من عمليات إدارة المعرفة.

بالإضافة إلى ما ذكر، ساهمت الدراسة بإضافة جديدة إلى الدراسات السابقة في مجال إدارة المعرفة حيث تعتبر واحده من الدراسات القليله التي اختبرت بشكل كامل العلاقة بين بنية إدارة المعرفة التحتية و عمليات إدارة المعرفة بشملها جميع العمليات. تشمل هذه العمليات عملية حماية المعرفة التي تعتبر اقل عمليه تم مناقشتها أو دراستها إحصائيا في دراسات إدارة المعرفة السابقة.